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ECONOMIC ASSESSMENT FOR THE AMENDED PROPOSED TSCA SECTION 4(a) TEST RULE FOR 21 HAZARDOUS AIR POLLUTANTS

Non-CBI Version

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I. OVERVIEW

On June 26, 1996, the U.S. Environmental Protection issued a proposed rule[1] under section 4(a) of the Toxic Substances Control Act (TSCA). This proposed test rule requires health effects testing for 21 hazardous air pollutants (HAPs). An economic analysis[2] was prepared for that proposal. The Agency is issuing an amended proposal, which requires the use of 11 TSCA test guidelines that have recently been finalized. This document is the revised economic assessment prepared in conjunction with the amended proposal.

The following table lists the HAP chemicals subject to the amended test rule proposal by their Chemical Abstracts Service (CAS) number:

CHEMICAL NAME	CAS NUMBER	CHEMICAL NAME	CAS NUMBER
1,1'-Biphenyl	92-52-4	Hydrogen Fluoride	7664-39-3
Carbonyl Sulfide	463-58-1	Maleic Anhydride	108-31-6
Chlorine	7782-50-5	Methyl Isobutyl Ketone	108-10-1
Chlorobenzene	108-90-7	Methyl Methacrylate	80-62-6
Chloroprene	126-99-8	Naphthalene	91-20-3
Cresols ortho- para- meta-	95-48-7 106-44-5 108-39-4	Phenol	108-95-2
Diethanolamine	111-42-2	Phthalic Anhydride	85-44-9
Ethylbenzene	100-41-4	1,2,4-Trichlorobenzene	120-82-1
Ethylene Dichloride	107-06-2	1,1,2-Trichloroethane	79-00-5
Ethylene Glycol	107-21-1	Vinylidene Chloride	75-35-4
Hydrochloric Acid	7647-01-0		

The estimated annualized test costs for the 21 hazardous air pollutants are based on the tests required by the Environmental Protection Agency (see Table 24). Laboratory costs are estimated to range between 18.2 and 31.6 million dollars (see Table 25). In addition to laboratory costs, expenses associated with the administration of the testing program are incurred by the companies subject to the test rule. These administrative costs are estimated to be 25 percent of the laboratory costs (i.e., 4.5 to 7.9 million dollars). The total cost of testing, therefore, is the

[1] See 61 FR 33178.

[2] USEPA. *Section 4 Test Rule Support for 21 Hazardous Air Pollutants*, Revised Draft, April 4, 1995.

sum of laboratory and administrative costs, or 22.7 to 39.5 million dollars.

The total test costs are annualized using a cost of capital of seven percent over a period of 15 years, which is believed to be representative of the chemical industry. Thus, the annualized test costs range from 2.5 to 4.3 million dollars. These specific cost elements are summarized as follows (the detailed cost elements are presented in Table 26):

COST ELEMENT	MINIMUM ($)	MAXIMUM ($)
Total Laboratory Costs	$18,180,801	$31,598,344
Total Administrative Costs	$ 4,545,200	$ 7,899,586
Total Test Costs	$22,726,001	$39,497,930
Total Annualized Test Costs	$ 2,495,193	$ 4,336,660

The objective of this report is to evaluate the economic impact of the required testing on these 21 hazardous air pollutants by determining if the amended test rule proposal will have a significant adverse economic impact on each chemical's market. A preliminary determination of the potential for significant adverse impact can usually be made on the basis of the anticipated unit test costs for the manufacturers of each chemical.

In this evaluation, if the unit costs of testing a chemical are less than one percent of the sales price of the chemical, then the potential for adverse economic impact due to the proposed test rule is low. Unit test costs greater than one percent of the chemical's sales price may indicate a greater potential for adverse economic impact.

This impact measure was applied to 19 of the 21 chemicals. In each case, the unit costs were less than one percent of the sales price and thus no adverse effects are predicted. For two of the 21 chemicals, carbonyl sulfide and 1,2,4-trichlorobenzene, alternative impact measures were required.

Carbonyl sulfide lacks any known full-scale commercial production in the United States; thus, no production data (CBI or non-CBI) are available. Carbonyl sulfide is, however, a byproduct of various industrial processes. Generators of carbonyl sulfide as a byproduct are subject to this rule. In 1995, 18 million pounds of carbonyl sulfide were released into the environment (see Appendix A). As a byproduct, an impact measure equivalent to the one used for chemicals that are produced for sale would compare the testing costs to the sales price of the product whose production generated the byproduct. Data were not available, however, to identify all the specific products involved, their prices, and their quantities of production. Therefore, to provide an upper-bound estimate of impacts, the annualized testing costs were compared to the sales price of carbon black, one of the largest generators of carbonyl sulfide. Since total annualized testing costs are compared to the value of only one of the relevant products, this test should provide an overestimate of the impacts. It shows that the impacts range from 0.025 percent to 0.042 percent, well under the one percent benchmark.

1,2,4-Trichlorobenzene has no non-CBI supply information; however, CBI production and import data does exist and, in 1994, production totaled more than 10 million pounds. The actual amount manufactured or imported as reported to EPA was ########## pounds (CBI) (USEPA 1995). Assuming the sales price remains constant at $1.25 per pound, a supply volume of at least 5.6 - 8.6 million pounds of 1,2,4-trichlorobenzene would be required for a price impact level of one percent or greater. As the supply of 1,2,4-trichlorobenzene is at least 10 million pounds, the price impact is assumed to be less than one percent. Table 28 presents the sales price required to support testing at the one percent of sales price impact level for various hypothetical supply volumes for 1,2,4-trichlorobenzene.

This analysis also evaluates the effect of TSCA section 12(b) on exporters of the HAP chemicals. According to regulations promulgated under TSCA section 12(b), all exporters of chemicals for which the submission of data is required under TSCA section 4(a) must give EPA a one-time notification for each country to which a subject chemical is shipped. Due to the low costs of reporting under section 12(b), the costs of one-time notification are expected to be insignificant in relation to exporter revenues. These costs are addressed separately in section IV.B. of this report.

II. PRODUCERS AND TRADE STATISTICS

This section uses non-CBI information to characterize the production and trade in the HAP chemicals that would be subject to the requirements of this test rule. For this section, EPA has compiled data from a variety of sources to present an overview of the commercial supply of the HAP chemicals. This economic assessment does not purport to contain an exhaustive listing of all manufacturers or importers of the HAP chemicals. Nor does it purport to present an accounting of all production of the chemicals. Rather, it is an assessment, drawn from available data, as to whether each HAP chemical generates a sufficient revenue stream to support the testing that EPA is proposing for that chemical.

To the extent that there are additional manufacturers or additional production of a particular HAP chemical resulting in a greater production volume than is accounted for by this assessment, the unit test costs, as a function of domestic production and imports, would be reduced, as would the price impact as a percentage of the sales price. Therefore, identifying additional production could result in identifying a larger number of manufacturers that could share the cost of conducting required testing under the amended HAPs proposal, thereby potentially reducing the burden of the testing requirements.

With the exception of carbonyl sulfide, the industry profile information provided in Sections II and III of this report is almost identical to that provided in the 1995 draft report

(USEPA 1995b). EPA believes that the industry profile information has not changed appreciably since the data collection for the 1995 report. The price and production data used in the economic analysis presented in Section IV, however, have been updated where possible. Table 26 provides the price and production data used in the analysis, along with the sources of that data.

A. 1,1'-BIPHENYL

1,1'-Biphenyl (also known as biphenyl or diphenyl) is produced by the following four companies (USEPA 1994a):

- Chemol Co. Greensboro, NC
- Koch Refining Co. Corpus Christi, TX
- Monsanto Co. Anniston, AL
- Sybron Chemicals Wellford, SC

The USITC reported 1,1'-biphenyl's 1993 production as 58.7 million pounds; sales totaled 32 million pounds (USITC-SOC 1994b).

1,1'-Biphenyl exports were not reported separately during 1990 - 1993; imports were reported only for 1992 and 1993, and totaled 1.6 and 0.6 million pounds, respectively (USDOC-EXP 1991-94; USDOC-IMP 1991-94).

Except for that produced by Monsanto, 1,1'-biphenyl is produced as a byproduct of the hydrodealkylation (HDA) of toluene to benzene; approximately 1 kg of 1,1'-biphenyl is recovered from the higher boiling residues per 100 kg of benzene produced. Approximately half of 1,1'-biphenyl produced in 1990 was derived from HDA sources. High purity 1,1'-biphenyl is produced by Monsanto by the direct dehydrocondensation of benzene. Byproduct 1,1'-biphenyl is generally shipped in the molten state by tank car or tank truck. Higher purity grades are either sold in the molten state in tank truck or tank car lots or as flakes in bags or drums (USEPA 1994a).

The list price for biphenyl ranges between $0.64 per pound (tanks, works) and $0.74 per pound (99% pure, carload, truckload, works) (CMR 1994a). Trade statistics are summarized in Table 1.

Table 1. Biphenyl Trade Statistics

Chemical Name and Trade Statistics	1990 (000 lbs)	1991 (000 lbs)	1992 (000 lbs)	1993 (000 lbs)
Biphenyl				
Production	53,604	na[4]	na	58,668
Sales	23,435	17,955	na	32,034
Imports	na	na	1,587	578
Exports	na	na	na	na
Supply (P+I)[3]	53,604	na	1,587	59,247
Price ($/lb)	na	na	na	0.64 - 0.74

Harmonized Tariff Schedule No. 2902.90.6000

Sources: CMR 1994a; USDOC-EXP 1991-94; USDOC-IMP 1991-94; USITC-SOC 1991, 1993, 1994a,b.

B. CARBONYL SULFIDE

Carbonyl sulfide is not produced in large quantities for commercial applications in the United States. It is, however, the most abundant sulfur-bearing compound in the atmosphere, although it is exceeded by hydrogen sulfide and sulfur dioxide in some industrial urban areas. Carbonyl sulfide is believed to originate from microbes, volcanoes, the burning of vegetation, and industrial processes. In industrial processes, carbonyl sulfide occurs as a byproduct in the manufacture of carbon disulfide, in many manufactured fuel gases and refinery gases, and in combustion products of sulfur-containing fuels. It also tends to be concentrated in the propane fraction in gas fractionation which requires an amine sweetening process for its removal (Kirk-Othmer 1983).

No commercial production volumes (CBI or non-CBI) are available for carbonyl sulfide (USEPA 1994b; USITC-SOC 1991, 1993, 1994a,b). Import and export data were, also, unavailable (USDOC-EXP 1991-94; USDOC-IMP 1991-94). No list prices were available due to the non-commercial nature of the compound (CMR 1994a).

According to the 1995 Toxic Release Inventory and the most recent AIRS Facility Subsystem records, 68 U.S. facilities produced carbonyl sulfide as a byproduct. These facilities

[3] "(P+I)" in this report denotes production plus imports.

[4] "na" in this report indicates that data are not available.

are associated with the production of carbon black, primary aluminum, inorganic pigments, and other industrial activities. Although no commercial trade statistics have been identified, as reflected in Table 2, 18 million pounds of carbonyl sulfide were reportedly released into the environment in 1995 (See Appendix A for additional information on production of carbonyl sulfide as a byproduct).

Table 2. Carbonyl Sulfide Trade Statistics

Chemical Name and Trade Statistics	**1991 (000 lbs)**	**1992 (000 lbs)**	**1993 (000 lbs)**
Carbonyl Sulfide			
Production	0	0	0
Imports	na	na	na
Exports	na	na	na
Supply (P+I)	0	0	0
Price ($/lb)	0.00	0.00	0.00

Harmonized Tariff Schedule No. (na)

Sources: CMR 1994a; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USEPA 1994b; USITC-SOC 1993, 1994a,b.

C. CHLORINE

Chlorine is produced by the twenty-four companies displayed in Table 3 (USEPA 1994c).

In 1993, 23.9 billion pounds of chlorine were produced in the United States (BOC-CIR 1994). Imports and exports for 1993 were 646.9 and 81.3 million pounds, respectively (USDOC-EXP 1994; USDOC-IMP 1994).

The list price for chlorine ranges between $225 and $255 per short ton (tanks, single units, works, fob, freight equaled) (CMR 1994a). This price range translates to $0.11 - $0.13 per pound. Trade statistics are summarized in Table 4.

Table 3. U.S. Manufacturers of Chlorine, 1993

Company Name	**Location**
Ashta Chemicals	Ashtabula, OH

Table 3. U.S. Manufacturers of Chlorine, 1993

Company Name	**Location**
Cedar Chemical Corp.	Vicksburg, MS
Dow Chemical USA	Freeport, TX; Plaquemine, LA
Du Pont	Niagara Falls, NY
Elf Atochem North America, Inc.	Portland, OR; Tacoma, WA
Formosa Plastics Corp. USA	Baton Rouge, LA
Fort Howard Corp.	Green Bay, WI; Muskogee, OK; Rincon, GA
General Electric Co.	Burkville, AL; Mount Vernon, IN
Georgia Gulf Corp.	Plaquemine, LA
Georgia-Pacific Corp.	Bellingham, WA; Brunswick, GA
The BF Goodrich Co.	Calvert City, KY
Hanlin Group, Inc.	Acme, NC; Brunswick, GA; Orrington, ME
La Roche Chemicals Inc.	Gramercy, LA
Magnesium Corp. of America	Rowley, UT
Miles Inc.	Baytown, TX; Niagara Falls, NY
Niachlor Inc.	Niagara Falls, NY
Occidental Chemical Corp.	Convent, LA; Corpus Christi, TX; Deer Park, TX; Delaware City, DE; La Porte, TX; Mobile, AL; Muscle Shoals, AL; Niagara Falls, NY; Tacoma, WA; Taft, LA
Olin Corp.	Augusta, GA; Charleston, TN; McIntosh, AL
Oregon Metallurgical Corp.	Albany, OR
Pioneer Chlor Alkali Co., Inc.	Henderson, NV; St. Gabriel, LA
PPG Industries, Inc.	Lake Charles, LA; Natrium, WV
Titanium Metals Corp.	Henderson, NV
Vulcan Materials Co.	Geismar, LA; Port Edwards, WI; Wichita, KS
Weyerhauser Co.	Longview, WA

Source: USEPA 1994c.

Table 4. Chlorine Trade Statistics

Chemical Name and Trade Statistics	1991 (000 lbs)	1992 (000 lbs)	1993 (000 lbs)
Chlorine			
Production	23,133,956	23,503,772	23,903,772
Imports	592,896	550,955	646,917
Exports	89,798	67,855	81,348
Supply (P+I)	23,726,852	24,054,727	24,550,689
Price ($/lb)	na	na	0.11 - 0.13

Harmonized Tariff Schedule No. 2801.10.0000

Sources: BOC-CIR 1993, 1994; CMR 1994a; USDOC-EXP 1992-94; USDOC-IMP 1992-94.

D. CHLOROBENZENE

Chlorobenzene (also known as monochlorobenzene) is produced by the following three companies (USEPA 1993a):

- Monsanto Co. — Sauget, IL
- Standard Chlorine of Delaware, Inc. — Delaware City, DE
- PPG Industries, Inc. — Natrum, WV

In 1993, US production of chlorobenzene totaled 195.3 million pounds (USITC-SOC 1994b). Imports and exports for 1992 were 3.6 and 0.22 million pounds, respectively (USDOC-EXP 1992-94; USDOC-IMP 1992-94). The list price for monochlorobenzene is $0.55 per pound (tanks, fob) (CMR 1994a). Trade statistics are summarized in Table 5.

Table 5. Chlorobenzene Trade Statistics

Chemical Name and Trade Statistics	1991 (000 lbs)	1992 (000 lbs)	1993 (000 lbs)
Chlorobenzene			
Production	210,170	231,913	195,264
Imports	43	149	3,601
Exports	572	208	220
Supply (P+I)	210,212	232,062	198,865
Price ($/lb)	na	na	0.55

Harmonized Tariff Schedule No. 2903.61.1000

Sources: CMR 1994a; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USITC-SOC 1993, 1994a,b.

E. CHLOROPRENE

Chloroprene is produced by the following two companies (CMR 1994c):

•	Du Pont	La Place, LA Louisville, KY
•	Miles	Houston, TX

The USITC does not itemize production data for chloroprene. However, the production of chloroprene can be approximately equated to the amount of polychloroprene (neoprene) produced since chloroprene is used almost exclusively to manufacture polychloroprene. Excluding Russia, China, and former Eastern Bloc countries, in 1989, polychloroprene world production was 321,000 tons; approximately half of this was consumed in the US (i.e., 160,500 tons (metric?) or 352,902,500 pounds (assuming metric tons at 2,205 pounds per metric ton)) (USEPA 1993b).

In 1993, polychloroprene demand (sales plus imports) was estimated to be 70,000 metric tons (or 154,350 thousand pounds) (CMR 1994c). This volume is used as an estimate of chloroprene supply for 1991.

Import and export data do not exist for chloroprene but does for polychloroprene rubbers (USDOC-EXP 1992-94; USDOC-IMP 1992-94).

The list price for chloroprene has not been identified in published sources; however, the

1993 list price for polychloroprene ranged between $1.51 -1.81 per pound (CMR 1994c). This price range will be used in this analysis. Trade statistics for polychloroprene are summarized in Table 6.

Table 6. Polychloroprene Trade Statistics

Chemical Name and Trade Statistics	**1991 (000 lbs)**	**1992 (000 lbs)**	**1993 (000 lbs)**
Polychloroprene			
Production	na	na	na
Imports	14,521	17,344	22,224
Exports	92,053	86,470	81,635
Supply (P+I)	160,965	17,344	154,350
Price ($/lb)	1.51 - 1.81	na	1.51 - 1.81

Harmonized Tariff Schedule No. 4002.41.0000 (latex of chloroprene)
Harmonized Tariff Schedule No. 4002.49.0000 (chloroprene rubber, excl latex)

1991 & 1993 supply figures represent estimated domestic demand (sales plus imports).

Sources: CMR 1991b, 1994c; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USITC-SOC 1993, 1994a,b.

F. CRESOLS

For this evaluation, cresols refers to individual cresol isomers (i.e., meta, ortho, para) or specific cresol mixtures (e.g., meta/para mixtures). The commercial mixture of cresol isomers, in which the meta-isomer predominates, is sometimes referred to as cresylic acid or cresylics. Cresylic acids contain cresols and small amounts of phenols and xylenols and they are defined as those mixtures in which over 50% will boil above 204°C (USEPA 1993c).

The following six companies have been identified as producing some type of cresols (mixed) (USEPA 1993c).

ortho-Cresol

• Aldrich Chemical Co.	Milwaukee, WI
• General Electric Co.	Selkirk, NY
• Merichem Co.	Houston, TX
• PMC, Inc.	Chicago, IL

meta-Cresol

• Aldrich Chemical Co.	Milwaukee, WI
• Merichem Co.	Houston, TX
• Rhone-Poulenc Inc.	Oil City, PA

para-Cresol

• Aldrich Chemical Co.	Milwaukee, WI
• Bell Flavors & Fragrances Inc.	Northbrook, IL
	Oakland, NJ
• Merichem Co.	Houston, TX
• PMC, Inc.	Chicago, IL

The USITC reported 1993 production of cresols to be 87.9 million pounds (USITC-SOC 1994b). Imports and exports for 1993 were 2.7 and 45.4 million pounds, respectively (USDOC-EXP 1994; USDOC-IMP 1994).

The list price ($/lb) for the specific cresol isomers/mixtures was reported as follows (CMR 1994a):

m-cresol	$1.15	(95-98% drums, truckload, fob)
	$1.15	(tanks, fob)
o-cresol	$0.66 - 0.70	(99% pure drums, truckload, fob)
	$0.66 - 0.70	(bulk, fob)
p-cresol	$1.37	(98% drums, truckload, fob)
	$1.37	(bulk, fob)
m/p-cresol	$0.94	(99% drums, truckload, fob)
	$0.82	(bulk, fob)

The price range used for this report is $0.66 - $1.37 per pound. Trade statistics are summarized in Table 7.

Table 7. Cresols Trade Statistics

Chemical Name and Trade Statistics	**1990 (000 lbs)**	**1991 (000 lbs)**	**1992 (000 lbs)**	**1993 (000 lbs)**
Cresols				
Production	84,352	na	74,613	87,918
Imports	3,571	4,197	3,842	2,701
Exports	3,686	3,771	5,327	45,449
Supply (P+I)	87,924	4,197	78,455	90,619
Price ($/lb)	na	na	na	0.66 - 1.37

Harmonized Tariff Schedule No. 2707.99.3000 (m-cresol, o-cresol, p-cresol and m/p-cresol w/ purity of 75% or more by weight)

Sources: CMR 1994a; USDOC-EXP 1991-94; USDOC-IMP 1991-94; USITC-SOC 1991, 1993, 1994a,b.

G. DIETHANOLAMINE

Four firms produce ethanolamines (mono-, **di-**, and triethanolamine) (USEPA 1993d):

- Dow — Plaquemine, LA; Midland, MI
- Occidental Petroleum — Bayport, TX
- Texaco — Port Neches, TX
- Union Carbide — Seadrift, TX

In 1993, the USITC reported a diethanolamine production volume of 215.9 million pounds (USITC-SOC 1994b).

The list price for diethanolamine is $0.52 per pound (tanks, freight allowed) (CMR 1994a). Import, export, and other trade statistics are summarized in Table 8.

Table 8. Diethanolamine Trade Statistics

Chemical Name and Trade Statistics	1991 (000 lbs)	1992 (000 lbs)	1993 (000 lbs)
Diethanolamine			
Production	198,304	200,000	215,900
Sales	166,345	164,808	na
Imports	3,054	739	1,010
Exports	92,613	85,457	72,492
Supply (P+I)	201,359	200,739	216,911
Price ($/lb)	0.00	0.00	0.52

Harmonized Tariff Schedule No. 2922.12.0000 (diethanolamine and its salts).

1992 production volume is estimated (MCP 1993b).

Sources: CMR 1994a; MCP 1993b; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USITC-SOC 1993, 1994a,b.

H. ETHYLBENZENE

Ethylbenzene is produced by ten firms (USEPA 1993e):

- Amoco — Texas City, TX
- Arco — Channelview, TX
- Chevron — St. James, LA
- Cos-Mar — Carville, LA
- Dow — Freeport, TX
- Huntsman — Bayport, TX
- Koch — Corpus Christi, TX
- Rexene — Odessa, TX
- Sterling — Texas City, TX
- Westlake — Lake Charles, LA

In 1993, ethylbenzene had a production volume of 9,336 million pounds of which 34.9 million pounds were exported; an additional 78.3 million were imported (USDOC-EXP 1994; USDOC-IMP 1994; USITC-SOC 1994b).

Ethylbenzene sells for $0.16 per pound (bulk, fob, Houston, TX) (CMR 1994a). Table 9 summarizes various trade statistics.

Table 9. Ethylbenzene Trade Statistics

Chemical Name and Trade Statistics	1991 (000 lbs)	1992 (000 lbs)	1993 (000 lbs)
Ethylbenzene			
Production	8,872,539	11,110,389	9,335,606
Imports	6,835	11,876	78,282
Exports	196,112	121,039	34,864
Supply (P+I)	8,879,373	11,122,264	9,413,888
Price ($/lb)	na	na	0.16

Harmonized Tariff Schedule No. 2902.60.0000

Sources: CMR 1994a; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USITC-SOC 1993, 1994a,b.

I. ETHYLENE DICHLORIDE

Eleven companies manufacture ethylene dichloride (CMR 1992c):

- Borden — Geismar, LA
- Dow — Freeport, TX; Oyster Creek, TX; Plaquemine, LA
- Formosa — Baton Rouge, LA; Point Comfort, TX
- Georgia Gulf — Plaquemine, LA
- BF Goodrich — La Porte, TX
- OxyChem — Convent, LA; Corpus Christi, TX
- Oxymar — Ingleside, TX
- PPG — Lake Charles, LA
- Vista — Lake Charles, LA
- Vulcan — Geismar, LA
- Westlake — Calvert City, KY

In 1993, ethylene dichloride had a production volume of 17,950 million pounds of which 2,317 million pounds were exported; an additional 276 million were imported (USDOC-EXP 1994; USDOC-IMP 1994; USITC-SOC 1994b).

Ethylene dichloride sells for $0.17 per pound (tanks, fob, works) (CMR 1994a). Table 10 summarizes various trade statistics.

Table 10. Ethylene Dichloride Trade Statistics

Chemical Name and Trade Statistics	**1991 (000 lbs)**	**1992 (000 lbs)**	**1993 (000 lbs)**
Ethylene Dichloride			
Production	13,715,107	15,152,882	17,949,930
Imports	10,842	300,025	276,109
Exports	1,456,894	1,808,999	2,316,639
Supply (P+I)	13,725,948	15,452,847	18,226,039
Price ($/lb)	na	na	0.17

Harmonized Tariff Schedule No. 2903.15.0000
Sources: CMR 1994a; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USITC-SOC 1993, 1994a,b.

J. ETHYLENE GLYCOL

Ethylene glycol is produced by the ten firms listed below (USEPA 1993f):

• BASF	Geismar, LA
• Dow	Plaquemine, LA
	Fort Saskatchewan, Canada
• Eastman	Longview, TX
• Hoechst Celanese	Clear Lake, TX
• Oxy Petrochemicals	Bayport, TX
• PD Glycol	Beaumont, TX
• Quantum	Morris, IL
• Shell	Geismar, LA
• Texaco	Port Neches, TX
• Union Carbide	Taft, LA
	Seadrift, TX
	Prentiss, Canada
	Montreal, Canada

Ethylene glycol had a 1993 production volume of 5,201 million pounds, of which 996.3

million pounds were exported and an additional 377 million pounds were imported (USDOC-EXP 1994; USDOC-IMP 1994; USITC-SOC 1994b).

The list price for ethylene glycol ranges between $0.20 per pound (industrial, tanks, freight allowed) and $0.24 per pound (polyester, tanks, fob) (CMR 1994a). Trade statistics are summarized in Table 11.

Table 11. Ethylene Glycol Trade Statistics

Chemical Name and Trade Statistics	1991 (000 lbs)	1992 (000 lbs)	1993 (000 lbs)
Ethylene Glycol			
Production	4,810,357	5,129,167	5,201,222
Imports	511,247	395,143	376,995
Exports	912,424	873,682	996,342
Supply (P+I)	5,321,605	5,524,310	5,578,217
Price ($/lb)	na	na	0.20 - 0.24

Harmonized Tariff Schedule No. 2905.31.0000

Sources: CMR 1994a; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USITC-SOC 1993, 1994a,b.

K. HYDROCHLORIC ACID

Forty-three firms covering 85 locations produce hydrochloric acid (USEPA 1994e). Table 12 presents a list of manufacturers for 1993.

In 1993, 6,981 million pounds of hydrochloric acid were produced in the United States (BOC-CIR 1994); 152.9 million pounds were imported and 88.4 million pounds were exported (USDOC-EXP 1994; USDOC-IMP 1994).

The list price for hydrochloric acid varies by geographic region and technical grade (usually 18, 20, 22, 23^{o} Be', corresponding to approximately 28, 31, 35, 37% HCL, respectively). The list prices are $/ton (tanks, works) and are as follows (CMR 1994a):

Region	20^{o} Be'	22^{o} Be'
East	$ 65 - 80	$ 78 - 86
Gulf	$ 75	$ 85
Midwest	$ 75	$ 85
West	$100 - 105	$110 - 115

Table 12. U.S. Manufacturers of Hydrochloric acid, 1993

Company Name	**Location**
Akzo Chemicals Inc.	Edison, NJ; Gallipolis Ferry, WV
Allied-Signal Inc.	Baton Rouge, LA; Danville, IL; El Segundo, CA
Ausimont USA, Inc.	Thorofare, NJ
BASF Corp.	Geismar, LA
Borden Chemicals & Plastics Partnership	Geismar, LA
Cabot Corp.	Tuscola, IL
CIBA-GEIGY Corp.	McIntosh, AL; St. Gabriel, LA
Degussa Corp.	Theodore, AL; Waterford, NY
Detrex Corp.	Ashtabula, OH
Dover Chemical Corp.	Dover, OH
Dow Chemical U.S.A.	Freeport, TX; Midland, MI; Oyster Creek, TX; Pittsburg, CA; Plaquemine, LA; La Porte, TX
Dow Corning Corp.	Carrollton, KY; Midland, MI
Du Pont	Parkersburg, WV; Antioch, CA; Corpus Christi, TX; Deepwater, NJ; Louisville, KY; Montague, MI; La Place, LA

Table 12. cont. U.S. Manufacturers of Hydrochloric acid, 1993

Company Name	**Location**
Elf Atochem North America, Inc.	Portland, OR; Tacoma, WA; Calvert City, KY; Wichita, KS; Riverview, MI
Ferro Corp.	Hammond, IN
FMC Corp.	Baltimore, MD; Nitro, WV
Formosa Plastics Corp. U.S.A.	Baton Rouge, LA; Point Comfort, TX
General Electric Co.	Mount Vernon, IN; Waterford, NY
Georgia Gulf Corp.	Plaquemine, LA
The BF Goodrich Co.	La Porte, TX
Hanlin Group, Inc.	Acme, NC; Brunswick, GA; Orrington, ME
ICI Americas Inc.	Cold Creek, AL; Geismar, LA; Mount Pleasant, TN
ISK Biotech	Greens Bayou, TX
Jones-Hamilton Co.	Waldbridge, OH
La Roche Chemicals Inc.	Gramercy, LA
Magnesium Corp. of America	Rowley, UT
Magnetics International Inc.	Burns Harbor, IN
Miles Inc.	Baytown, TX; New Martinsville, WV
Monsanto Co.	Bridgeport, NJ; Sauget, IL
Occidental Chemical Corp.	Belle, WV; Deer Park, TX; Niagara Falls, NY; Tacoma, WA
Olin Corp.	Augusta, GA; Charleston, TN; Lake Charles, LA
Oxymar	Ingleside, TX
Pioneer Chlor Alkali Co., Inc.	Henderson, NV
PPG Industries, Inc.	Barberton, Ohio; Lake Charles, LA; Natrium, WV; La Porte, TX

Table 12. cont. U.S. Manufacturers of Hydrochloric acid, 1993

Company Name	Location
Rhone-Poulenc Ag Co.	Institute, WV
Shell Chemical Co.	Norco, LA
Standard Chlorine Chemical Co., Inc.	Delaware City, DE
Velsicol Chemical Corp.	Chattanooga, TN; Memphis, TN
Vista Chemical Co.	Baltimore, MD; Lake Charles, LA
Vulcan Materials Co.	Geismar, LA; Port Edwards, WI; Wichita, KS
Westlake Monomers Corp.	Calvert City, KY
Weyerhauser Co.	Longview, WA
Witco Corp.	Phillipsburg, NJ

Source: USEPA 1994e.

As shown above, hydrochloric acid prices range between $65 and $115 per ton (tanks, works). This price range translates to $0.0325 - $0.0575 per pound. Trade statistics are summarized in Table 13.

Table 13. Hydrochloric Acid Trade Statistics

Chemical Name and Trade Statistics	1991 (000 lbs)	1992 (000 lbs)	1993 (000 lbs)
Hydrochloric Acid			
Production	6,758,812	7,215,920	6,980,565
Imports	622,862	490,454	152,923
Exports	78,613	94,632	88,440
Supply (P+I)	7,381,674	7,706,374	7,133,488
Price ($/lb)	na	na	0.03 - 0.06

Harmonized Tariff Schedule No. 2806.10.0000
Sources: BOC-CIR 1993, 1994; CMR 1994a USDOC-EXP 1992-94; USDOC-IMP 1992-94.

L. HYDROGEN FLUORIDE

Three companies manufacture hydrogen fluoride (USEPA 1993g):

- Allied-Signal — Geismar, LA
- Atochem North America — Calvert City, KY
- Du Pont — La Porte, TX

In 1993, 341.2 million pounds of hydrogen fluoride were produced in the U.S. (BOC-CIR 1994); an additional 138.8 million pounds were imported and 20 million pounds were exported (USDOC-EXP 1994; USDOC-IMP 1994).

Hydrogen fluoride sells for $52 per 100 pounds (aqueous, 70% tanks, fob, freight allowed) (CMR 1994a) or $0.52 per pound. Table 14 summarizes various trade statistics.

Table 14. Hydrogen Fluoride Trade Statistics

Chemical Name and Trade Statistics	**1991 (000 lbs)**	**1992 (000 lbs)**	**1993 (000 lbs)**
Hydrogen Fluoride			
Production	323,813	362,632	341,173
Imports	209,740	155,313	138,801
Exports	17,784	16,867	20,036
Supply (P+I)	533,553	517,945	479,974
Price ($/lb)	na	na	0.52

Harmonized Tariff Schedule No. 2811.11.0000

Sources: BOC-CIR 1993, 1994; CMR 1994a; USDOC-EXP 1992-94; USDOC-IMP 1992-94.

M. MALEIC ANHYDRIDE

Maleic anhydride is produced by (USEPA 1993h):

- Amoco — Joliet, IL
- Aristech — Neville Island, PA
- Ashland — Neal, WV
- Miles — Houston, TX
- Monsanto — Pensacola, FL

Of the 358.5 million pounds of maleic anhydride produced in 1993, 55.8 million pounds were exported; an additional 16.1 million pounds were imported (USDOC-EXP 1994; USDOC-

IMP 1994; USITC-SOC 1994b).

Maleic anhydride is available as briquettes and capulets, and in molten form (USEPA 1993h). The current list price for maleic anhydride ranges from $0.48 to $0.50 per pound (bags, truckload, works, freight equaled) and $0.51 per pound (tanks, works, freight equaled) (CMR 1994a). Trade statistics are summarized in Table 15.

Table 15. Maleic Anhydride Trade Statistics

Chemical Name and Trade Statistics	**1991 (000 lbs)**	**1992 (000 lbs)**	**1993 (000 lbs)**
Maleic Anhydride			
Production	380,861	436,023	358,491
Imports	7,853	11,900	16,092
Exports	20,924	56,342	55,773
Supply (P+I)	388,714	447,924	374,583
Price ($/lb)	na	na	0.48 - 0.51

Harmonized Tariff Schedule No. 2917.14.1000 (derived from aromatics)
Harmonized Tariff Schedule No. 2917.14.5000 (derived from other)

Sources: CMR 1994a; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USITC-SOC 1993, 1994a,b.

N. METHYL ISOBUTYL KETONE

Methyl isobutyl ketone is produced by the following three firms (USEPA 1993i):

- Eastman — Kingsport, TN
- Shell — Deer Park, TX
- Union Carbide — Institute, WV

Methyl isobutyl ketone had a 1993 production volume of 150.1 million pounds; an additional 14.8 million pounds were imported (USDOC-IMP 1994; USITC-SOC 1994b). Exports were 30.4 million pounds in 1993 (USDOC-EXP 1994).

The list price for methyl isobutyl ketone varies by geographic region. The list prices are $/pound (tanks, delivered) and are as follows (CMR 1994a):

Zone 1 (East)	$0.51
Zone 2 (CA, AZ)	$0.53

Zone 3 (other West of Rockies) $0.53

As shown above, prices range between $0.51 and $0.53 per pound (tanks, delivered). Trade statistics are summarized in Table 16.

Table 16. Methyl Isobutyl Ketone Trade Statistics

Chemical Name and Trade Statistics	**1991 (000 lbs)**	**1992 (000 lbs)**	**1993 (000 lbs)**
Methyl Isobutyl Ketone			
Production	180,918	164,273	150,072
Imports	7,040	21,633	14,790
Exports	34,352	37,876	30,355
Supply (P+I)	187,958	185,906	164,862
Price ($/lb)	na	na	0.51 - 0.53

Harmonized Tariff Schedule No. 2914.13.0000

Sources: CMR 1994a; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USITC-SOC 1993, 1994a,b.

O. METHYL METHACRYLATE

Three firms produce methyl methacrylate (CMR 1994b; USEPA 1993j):

• Cyro Industries	Fortier, LA
• ICI	Beaumont, TX
	Memphis, TN
• Rohm and Haas	Deer Park, TX

There were 1,148 million pounds of methyl methacrylate produced in 1993 of which 104.2 million pounds were exported (USDOC-EXP 1994; USITC-SOC 1994b). Imports were 26.9 million pounds in 1993 (USDOC-IMP 1994).

Methyl methacrylate sells for $0.71 per pounds (tanks, delivered) (CMR 1994a). Table 17 summarizes various trade statistics.

Table 17. Methyl Methacrylate Trade Statistics

Chemical Name and Trade Statistics	**1991 (000 lbs)**	**1992 (000 lbs)**	**1993 (000 lbs)**
Methyl Methacrylate			
Production	1,102,037	1,207,952	1,148,428
Imports	3,161	10,200	26,880
Exports	109,427	119,931	104,181
Supply (P+I)	1,105,198	1,218,152	1,175,308
Price ($/lb)	na	na	0.71

Harmonized Tariff Schedule No. 2916.14.0020

Sources: CMR 1994a; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USITC-SOC 1993-94.

P. NAPHTHALENE

The following three firms manufacture naphthalene (CMR 1993e; USEPA 1993k):

- Advanced Aromatics Baytown, TX
- Allied Signal Ironton, OH
- Koppers Follansbee, WV

There were 273.6 million pounds of naphthalene produced in 1992 (no production data was published for 1993); imports accounted for another 16.1 million pounds while exports totaled 5.6 million pounds in 1992 (USDOC-EXP 1993; USDOC-IMP 1993; USITC-SOC 1994a,b).

Naphthalene's list price ranges between $0.29 and $0.40 per pound. Three categories of products exist:

- domestic, 78 deg., tanks, works $0.29 - 0.30 / pound

- petroleum, 80 deg., tanks, fob $0.39 - 0.40 / pound

- refined, balls, flake, wholesalers drums, works $0.39 - 0.40 / pound

Trade statistics for naphthalene are summarized in Table 18.

Table 18. Naphthalene Trade Statistics

Chemical Name and Trade Statistics	1991 (000 lbs)	1992 (000 lbs)	1993 (000 lbs)
Naphthalene			
Production	na	273,585	na
Imports	15,314	16,142	5,573
Exports	3,261	5,605	4,071
Supply (P+I)	15,314	289,728	5,573
Price ($/lb)	na	na	0.29 - 0.40

Harmonized Tariff Schedule No. 2707.40.0000

Sources: CMR 1994a; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USITC-SOC 1993, 1994a,b.

Q. PHENOL

The eleven phenol producers include (USEPA 1994f):

• Allied Signal	Frankford, PA
• Aristech	Haverhill, OH
• BTL	Blue Island, IL
• Dakota Gasification	Beulah, ND
• Dow	Freeport, TX
• General Electric	Mount Vernon, IN
• Georgia Gulf	Pasadena, TX
	Plaquemine, LA
• Kalama	Kalama, WA
• Merichem	Houston, TX
• Shell	Deer Park, TX
• Texaco	El Dorado, KS

In 1993, the USITC reported a production volume of 3,405 million pounds for phenol (USITC-SOC 1994b). The 1993 imports and exports were 42.0 and 228.5 million pounds, respectively (USDOC-EXP 1994; USDOC-IMP 1994).

Phenol (synthetic, tanks, freight equaled) sells for $0.28 - 0.33 per pound (CMR 1994a). Table 19 summarizes the trade statistics.

Table 19. Phenol Trade Statistics

Chemical Name and Trade Statistics	1991 (000 lbs)	1992 (000 lbs)	1993 (000 lbs)
Phenol			
Production	3,597,722	3,886,271	3,405,010
Imports	11,539	20,804	42,049
Exports	161,298	248,427	228,475
Supply (P+I)	3,609,261	3,907,075	3,447,058
Price ($/lb)	na	na	0.28 - 0.33

Harmonized Tariff Schedule No. 2907.11.000 (phenol and its salts)

Sources: CMR 1994a; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USITC-SOC 1993, 1994a,b.

R. PHTHALIC ANHYDRIDE

Phthalic anhydride is produced by these five companies (USEPA 1993l):

- Aristech — Pasadena, TX
- Exxon — Baton Rouge, LA
- Koppers — Cicero, IL
- Stepan — Millsdale, IL
- Sterling — Texas City, TX

There were 853.6 million pounds of phthalic anhydride produced in 1993 of which 37.5 million pounds were exported; an additional 63.4 million pounds were imported (USDOC-EXP 1994; USDOC-IMP 1994; USITC-SOC 1994b).

Phthalic anhydride is available in flakes or molten form and price varies accordingly:

- flake carload, truckload, drums, freight equaled	$0.35 - 0.45 / pound
- tanks, freight equaled	$0.33 - 0.35 / pound

The price range used for this report is $0.33 - $0.45 per pound. Trade statistics are summarized in Table 20.

Table 20. Phthalic Anhydride Trade Statistics

Chemical Name and Trade Statistics	1991 (000 lbs)	1992 (000 lbs)	1993 (000 lbs)
Phthalic Anhydride			
Production	587,141	898,207	853,584
Imports	27,938	53,060	63,425
Exports	77,671	46,252	37,549
Supply (P+I)	615,078	951,267	917,010
Price ($/lb)	na	na	0.33 - 0.45

Harmonized Tariff Schedule No. 2917.35.0000

Sources: CMR 1994a; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USITC-SOC 1993, 1994a,b.

S. 1,2,4-TRICHLOROBENZENE

1,2,4-trichlorobenzene is produced by Standard Chlorine of Delaware (Delaware City, DE), where it is both sold and used as a formulating ingredient. All chlorobenzenes are presently produced by the catalytic chlorination of benzene, an ortho-, para-directed reaction. Therefore, 1,2,4-trichlorobenzene may be produced as a byproduct or an impurity in the production of large production chlorobenzenes such as monochlorobenzene, o-dichlorobenzene, and p-dichlorobenzene (USEPA 1993m).

According to the 1991 Toxic Chemical Release Inventory (TRI) submissions, there are 11 facilities that manufacture or import 1,2,4-trichlorobenzene, nine facilities that manufacture 1,2,4-trichlorobenzene, and three facilities that import 1,2,4-trichlorobenzene. The additional producers of 1,2,4-trichlorobenzene are:

- Monsanto Co. (Sauget, IL) which produces it as a byproduct;
- Occidental Chemical (High Point, NC) which imports it for on-site use as a formulating ingredient;
- PPG Industries (Westlake, LA and New Martinsville, WV) which produces it as a byproduct and for sale;
- Sandoz Agro Inc. (Beaumont, TX) which imports it for on-site use as a reactant;
- Sun Ref. & Mrktg Co. (Marcus Hook, PA) which produces and imports chemicals in which it is an impurity;

- Vista Chemical Co. (Westlake, LA) which produces it as a byproduct;
- Virkler Co. (Charlotte, NC) which produces it for sale and uses it as a formulating ingredient;
- Westlake Monomers (Calvert City, KY) which produces it for on-site use as a reactant (USEPA 1993m).

No non-CBI production, export, or import information is available for 1,2,4-trichlorobenzene (USDOC-EXP 1991-93; USDOC-IMP 1991-93; USITC-SOC 1991, 1993, 1994a,b); however, CBI supply data does exist. In 1994, over 10 million pounds of 1,2,4-trichlorobenzene were manufactured or imported [######### pounds manufactured (CBI) with an additional ######### pounds (CBI) being imported (USEPA 1995)].

1,2,4-Trichlorobenzene (pure, tanks, delivered) sells for $1.25 per pound (CMR 1994a). Table 21 summarizes the trade statistics.

Table 21. 1,2,4-Trichlorobenzene Trade Statistics

Chemical Name and Trade Statistics	**1991 (000 lbs)**	**1992 (000 lbs)**	**1993 (000 lbs)**	**1994 (000 lbs)**
1,2,4-Trichloroethane				
Production	na	na	na	CBI
Imports	na	na	na	CBI
Exports	na	na	na	na
Supply (P+I)	na	na	na	CBI
Price ($/lb)	na	na	1.25	na

Harmonized Tariff Schedule No. (na) (basket category 2903.69.1000)

Sources: CMR 1994a; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USEPA 1995; USITC-SOC 1993, 1994a,b.

T. 1,1,2-TRICHLOROETHANE

1,1,2-Trichloroethane is produced by two firms (USEPA 1994g):

- Dow Chemical USA Freeport, TX
- PPG Industries, Inc. Lake Charles, LA

It is produced primarily as a co-product of various chlorination processes, such as the manufacture of 1,2-dichloroethane and the chlorination of ethane or 1,1-dichloroethane to produce 1,1,1-trichloroethane. 1,1,2-trichloroethane is also produced when co-product sources are inadequate or for balancing feedstocks. The liquid-phase chlorination of 1,2-dichloroethane is an often-used route for synthesizing 1,1,2-trichloroethane (USEPA 1994g).

No non-CBI production, export, or import information was available for 1,1,2-trichloroethane (USDOC-EXP 1991-94; USDOC-IMP 1991-94; USEPA 1994g; USITC-SOC 1991, 1993, 1994a,b). Demand for 1,1,2-trichloroethane can be estimated from vinylidene chloride production since the primary use of 1,1,2-trichloroethane is to produce vinylidene chloride and since vinylidene chloride is produced almost exclusively from 1,1,2-trichloroethane. Since the U.S. demand for vinylidene chloride in 1987 was 68,000 metric tons (149,940 thousand pounds) and was projected to rise to 79,000 metric tons (174,195 thousand pounds) in 1992, the corresponding 1987 demand and 1992 projected demand for 1,1,2-trichloroethane would be 94,000 metric tons (207,270 thousand pounds) and 110,000 metric tons (242,550 thousand pounds), respectively, assuming a 100 percent yield (USEPA 1994g).

The list price (tanks, fob, works) is $0.42 per pound for 1,1,2-trichloroethane (CMR 1994a). The available trade statistics are contained in Table 22.

Table 22. 1,1,2-Trichloroethane Trade Statistics

Chemical Name and Trade Statistics	1991 (000 lbs)	1992 (000 lbs)	1993 (000 lbs)
1,1,2-Trichloroethane			
Production	na	242,550	na
Imports	na	na	na
Exports	na	na	na
Supply (P+I)	na	242,550	na
Price ($/lb)	na	na	0.42

Harmonized Tariff Schedule No. (na) (basket category 2903.19.5000)

Sources: CMR 1994a; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USEPA

1994g; USITC-SOC 1993, 1994a,b.

U. VINYLIDENE CHLORIDE

Vinylidene chloride is produced by two firms (USEPA 1994h):

- Dow Chemical USA — Freeport, TX
- PPG Industries, Inc. — Lake Charles, LA

It is almost exclusively produced from 1,1,2-trichloroethane, primarily by liquid-phase dechlorination in the presence of alkali (USEPA 1994h).

No non-CBI production information is available for vinylidene chloride (USEPA 1994h; USITC-SOC 1991, 1993, 1994a,b). In 1987, the U.S. demand for vinylidene chloride was 68,000 metric tons (149,940 thousand pounds) and was projected to rise to 79,000 metric tons (174,195 thousand pounds) in 1992. One industry source estimated the 1989 production volume to be 230 million pounds (USEPA 1994h).

The list price for vinylidene chloride monomer (bulk, Freeport, TX) is $0.37 per pound (Dow 1994). Published and estimated trade statistics are shown in Table 23.

Table 23. Vinylidene Chloride Trade Statistics

Chemical Name and Trade Statistics	1991 (000 lbs)	1992 (000 lbs)	1993 (000 lbs)
Vinylidene Chloride			
Production	na	174,195	na
Imports	3,293	4,995	7,234
Exports	16,246	19,122	19,726
Supply (P+I)	3,293	179,190	7,234
Price ($/lb)	na	na	0.37

Harmonized Tariff Schedule No. 3904.50.0000 (vinylidene chloride polymers)
Harmonized Tariff Schedule No. (na) (monomer in basket category 2903.29.0000)

Sources: CMR 1994a; Dow 1994; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USEPA 1994h; USITC-SOC 1993, 1994a,b.

III. USES AND MARKET TRENDS

A. 1,1'-BIPHENYL

1,1'-Biphenyl is used as a heat transfer agent, a dye carrier for polyesters, a feedstock, especially in the production of alkylbiphenyls, and a citrus fruit wrapping impregnate to reduce spoilage.

One common heat transfer fluid, Dowtherm A, is a eutectic mixture containing 26.5% biphenyl and 73.5% diphenyl ether. About 10% of the byproduct biphenyl is consumed as technical grade (93-95%) material as a textile dye carrier and the rest is used as an alkylation feedstock or purified and used as a heat transfer agent. High purity biphenyl from the dehydrocondensation of benzene is used as a heat transfer agent or alkylated. Alkylated biphenyls are used as heat transfer agents and dielectric fluids in condensers (USEPA 1994a).

1,1'-Biphenyl is listed as an important and commonly found food preservative. The U.S. FDA lists it as a flavor enhancer or adjuvant. The label notation for biphenyl is E230 and the recommended concentration range is 50-70 ppm (USEPA 1994a).

The use of biphenyl as a dye carrier in the textile industry has been on the decline because of environmental concerns over the amount of biphenyl released in wastewater effluents by the many plants that dye textiles. Biphenyl in these effluents may be converted to PCBs during chlorination of wastewater (USEPA 1994a).

Formerly, biphenyl was chlorinated to form polychlorinated biphenyls (PCBs) for use as a nonflammable hydraulic fluid and transformer dielectric. Production of PCBs ceased precipitously in 1972 when they were recognized as serious environmental contaminants (USEPA 1994a).

No market trend or growth rate data have been located as of yet for biphenyl.

B. CARBONYL SULFIDE

Carbonyl sulfide's commercial importance is limited. It is not manufactured in large quantities and is used only for small scale-synthesis and experiments. Previous applications included the synthesis of thio organic compounds, such as the herbicide triallate (USEPA 1994b). Appendix A contains additional information on the industry sectors associated with the byproduction of carbonyl sulfide.

C. CHLORINE

Chlorine is one of the top 50 industrial chemicals in the US, ranking 9th and 10th for 1991 and 1992, respectively (C&EN 1993). It is used primarily as a raw material for a wide variety of organic and inorganic compounds. The 1993 estimated end-use pattern for chlorine is (MCP 1993a):

Derivative	**Percent**
Ethylene dichloride /vinyl chloride monomer	35
Pulp & paper	11
Propylene oxide	8
Chlorinated ethanes	5
Chlorinated methanes	4
Other organic chemicals	16
Inorganic chemicals	11
Water treatment	5
Miscellaneous	5

Over one third of all chlorine production is used in the manufacture of polyvinyl chloride (PVC) via ethylene dichloride (EDC). EDC is an intermediate for vinyl chloride monomer and PVC resins. The second largest application is as a bleach in the pulp and paper industry (MCP 1993a).

Chlorine is consumed in the manufacture of propylene oxide (via the chlorohydrin process) which is used in polyurethane products and propylene glycols. It is also used to make phosgene, a raw material for isocyanates (CMR 1992a; MCP 1993a).

Numerous organic and inorganic compounds are synthesized utilizing chlorine. Many of the organics find uses as solvents in metal cleaning, dry cleaning, CFC/HCFC production, etc. Chlorine is used in the production of propylene oxide, carbon tetrachloride, perchloroethylene, hypochlorite, epichlorohydrin, 1,1,1-trichloroethane, methylene chloride, ethylene dichloride (solvent and trade), trichloroethylene, chlorobenzene, chloroprene, bromine, and numerous other organic compounds. Inorganic compounds include titanium oxide and hydrochloric acid (CMR 1992a; MCP 1993a; USEPA 1994c).

Chlorine is a slimicide and a sanitizing and disinfecting agent for municipal water supplies and swimming pools. Chlorine is also used as an etching gas in the semiconductor industry.

Chlorine is used in sewage treatment and in the pharmaceutical and textile industries (USEPA 1994c).

Mature end-uses and increasing environmental regulation will continue to impact future chlorine demand by declining consumption in pulp bleaching, CFCs, and chlorinated solvents, and growing demand in polyvinyl chloride intermediates, titanium dioxide, and phosgene. Historically, chlorine grew at a rate of 2.5 percent per year from 1982 through 1991; however, future growth is projected to be about 0.5 percent per year through 1996 (CMR 1992a; MCP 1993a).

D. CHLOROBENZENE

Chlorobenzene (also known as monochlorobenzene) is used in a range of products. The 1993 estimated end-use pattern for chlorobenzene is (CMR 1993a):

Derivative	**Percent**
Nitrochlorobenzenes	50
Solvents	23
Diphenyl oxide and phenylphenols	22
Polysulfone polymers	4
Miscellaneous	1

Chlorobenzene is used largely in the production of nitrochlorobenzene, which, in turn, is used in the manufacture of dyes and pigments, rubber processing chemicals, antioxidants, pesticides, and pharmaceuticals. It is also used as a solvent in herbicide formulations and other agricultural products, in isocyanate processing, and in degreasing (CMR 1993a; MCP 1990; USEPA 1993a).

In the past, large amounts of chlorobenzene were used to manufacture phenol, aniline, and DDT. However, these uses have essentially disappeared due to the adoption of new processes and the phase-out of DDT (USEPA 1993a).

Historically, chlorobenzene grew at a rate of minus 1 percent per year from 1983 through 1992; however, future growth is projected to be about 2 percent per year through 1995, but a potential fall off late in the decade (CMR 1993a; MCP 1993a).

E. CHLOROPRENE

Used almost entirely in the production of polychloroprene (i.e., neoprene) synthetic rubbers, chloroprene's only other use of significant volume is the manufacture of 2,3-dichloro-1,3-butadiene which is used as a monomer in chloroprene copolymerizations (USEPA 1993b).

Since chloroprene is used almost entirely in the production of polychloroprene, the 1993 estimated end-use pattern for polychloroprene is (CMR 1994c):

Derivative	Percent
Industrial (belts, hosing, flooring)	33
Mechanical	30
Adhesives	10
Latexes	10
Wire and Cable	6
Cellular rubber	4
Miscellaneous (incl. consumer goods)	7

Polychloroprene, historically, grew at a rate of minus 3 percent per year from 1984 through 1993; however, future growth is projected to range between 0 and 1 percent per year through 1998 (CMR 1994c).

F. CRESOLS

Specific end-use patterns for the each cresol isomer/mixture have not been identified but are discussed below. However, the estimated 1993 end-use pattern for cresylics (which includes cresols and cresylic acids) is as follows (CMR 1993b):

Derivative	Percent
Exports	35
Antioxidants	20
Phenolic, epoxy, novolac resins	15
Wire and enamel solvent	12
Phosphate esters	5
Intermediate	5
Miscellaneous (incl. cleaning &disinfectant cmpds and ore flotation)	8

ortho-Cresol is primarily used as either a solvent or disinfectant. It is also used as a chemical intermediate for a wide variety of products including 2-methylcyclohexanol, 2-methylcyclohexanone, coumarin, and 3-isopropyl-6-methyl phenol (carvacrol). ortho-Cresol is also used in the manufacture of several antioxidants, dyes, and in the formation of epoxy-o-cresol novolac (ECN) resins. ECN resins are sealing materials for integrated circuits (silicon chips). ortho-Cresol is also used as an additive to phenol-formaldehyde resins. Furthermore, the manufacture of certain herbicides and pesticides, including 4-chloro-2-methylphenoxyacetic acid (MCPA), 2-(4-chloro-2-methylphenoxy)-propionic acid (MCPP), .g.-(4-chloro-2-methylphenoxy)-butyric acid (MCPB), and 4,6-dinitro-o-cresol (DNCO), is dependent upon ortho-cresol (USEPA 1993c).

meta-Cresol, either pure or mixed with para-cresol, is important in the production of contact herbicides such as O,O-dimethyl-O-(3-methyl-4-nitrophenyl) thionophosphoric acid (fenitrothion) and O,O-dimethyl-O-(3-methyl-4-methyl thiophenyl)thionophosphoric acid ester (fenthion). meta-Cresol is also used as a precursor to pyrethroid insecticides. Many flavor and fragrance compounds, such as (-)-methanol and musk amberette, are derived from meta-cresol. Furthermore, meta-cresol is used in the manufacture of the explosive, 2,4,6-trinitro-m-cresol (USEPA 1993c).

para-Cresol is largely used in the production of antioxidants such as 2,6-di-tert-butyl-p-cresol (BHT), 2,6-dicyclopentyl-p-cresol, 2,2'-methylene- or 2,2'-thiodiphenols, and Tinuvin 326. Tinuvin 326 is a substituted hydroxyphenyl benzotriazole which is an absorber of UV light and is used in films and coatings. para-Cresol also has many applications in the fragrance and dye industries. para-Cresol carboxylic acid esters and anisaldehyde are used in perfumes (USEPA 1993c).

Mixtures of meta- and para-cresol often serve as disinfectants and preservatives. Cresols are added to soaps and disinfectants. They are used as wood preservatives, in ore flotation, and in fiber treatment. meta- and para-Cresol mixtures are used in the manufacture of tricresyl phosphate and diphenyl cresyl phosphate, which are used in flame-retardant plasticizers for polyvinylchloride (PVC) and other plastics, fire-resistant hydraulic fluids, additives for lubricants, and air filters. Cresols are used in paints, textiles, modifying phenolic resins, as solvents for synthetic resin coatings such as wire enamels, metal degreasers, and cutting oils, and as agents to remove carbon deposits from combustion engines (USEPA 1993c).

Although growth rates for the individual cresols have not been identified, cresylics, historically, grew at a rate of minus 3 percent per year from 1983 through 1992; however, future growth is projected to range between 0 and minus 1 percent per year through 1997 (CMR 1993b).

G. DIETHANOLAMINE

The 1992 use pattern for ethanolamines is as follows (MCP 1993b):

Derivative	Percent
Detergents	38
Gas purification	25
Ethylene amines	14
Corrosion inhibitors & Metal working	11
Miscellaneous (including cement grinding oils, agricultural chemicals, and synthesis)	12

Diethanolamine is used as a chemical intermediate in the production of surfactants, personal care products such as creams, lotions, shampoos, soaps and cosmetics, and detergents. Alkanolamine-based surfactants are generally alkanolamides (nonionic surfactants) and alkanolamine salts (anionic surfactants). It is used in adhesives, cleaners, coatings, corrosion inhibitors for ferrous metals in applications such as coolant systems, lubricating oils, metal working fluids, petroleum antifouling and drilling, and electroplating baths. It is used for "sweeting" natural gas and neutralizing acid herbicides. DEA or its derivatives are also used in many facets of textile production (USEPA 1993d).

Most end-uses for ethanolamines are mature. Long term growth is expected to be moderate. Over the next five years, growth will probably not exceed 3 percent per year (MCP 1993b).

H. ETHYLBENZENE

Ethylbenzene is one of the top 50 industrial chemicals in the US, ranking 20th and 18th for 1991 and 1992, respectively (C&EN 1993). Over 99 percent of ethylbenzene is used captively in the manufacture of styrene, which, in turn, is used to produce a variety of plastic and resin materials, the largest being polystyrene. The remainder is used in other applications, such as a solvent in the paint industry, as an intermediate for dyes, diethylbenzene, acetophenone, and ethyl anthraquinone. Ethylbenzene is a component of gasoline (MCP 1993c; USEPA 1993e).

Since styrene derivatives are employed heavily in the construction, packaging, automotive industries and use in the manufacture of consumer goods, ethylbenzene demand is directly related to the gross domestic product. Historically, ethylbenzene grew at a rate of 6.2 percent per year from 1982 through 1991; however, future growth is projected to be about 2.5 percent per year through 1996 (CMR 1992b; MCP 1993c).

I. ETHYLENE DICHLORIDE

Ethylene dichloride (also known as 1,2-dichloroethane) is one of the top 50 industrial chemicals in the US, ranking 15th and 14th for 1991 and 1992, respectively (C&EN 1993). Its 1992 estimated end-use pattern is as follows (MCP 1993d):

Derivative	**Percent**
Vinyl chloride monomer	94
Intermediate	5
Miscellaneous	1

Ethylene dichloride is used mainly for the production of vinyl chloride monomer (VCM). VCM is used almost exclusively to manufacture polyvinyl chloride (PVC), copolymers of VCM (e.g., VCM-vinyl acetate), and chlorinated PVC. As an intermediate, ethylene dichloride derivatives include ethylene diamines and chlorinated solvents such as perchloroethylene, trichloroethylene, and 1,1,1-trichloroethane. Miscellaneous applications include solvents for rubber, resins, fats, oils, and waxes (MCP 1993d; USEPA 1994d).

Ethylene dichloride demand is nearly dependent on PVC demand due environmental pressures on the chlorinated solvents sector. While historical growth rates averaged 4.1 percent per year (1982 -1991), future growth through 1996 will average 3.5 percent per year (CMR 1992c; MCP 1993d).

J. ETHYLENE GLYCOL

Ethylene glycol is one of the top 50 industrial chemicals in the US, ranking 30th in both 1991 and 1992 (C&EN 1993). The 1992 estimate of ethylene glycol's end-use pattern is as follows (MCP 1993e):

Derivative	**Percent**
Polyester:	
Fibers	30
Plastics (films/bottles)	22
Antifreeze	38
Miscellaneous	10

The major end-use for ethylene glycol is in the manufacture of polyethylene terephthalate (PET) resin, which is used for fibers, films, bottles, and other molded plastics, laminates, and castings. Ethylene glycol is used as an antifreeze in heating and cooling systems, a de-icing agent on bridges and airport runways, and a solvent in the paints and plastics industry. It is used in hydraulic brake fluids, printer's inks, and inks for stamp pads and ball point pens (MCP 1993e; USEPA 1993f).

Historically, ethylene glycol grew at a rate of 2 percent per year from 1983 through 1992; however, future growth is projected to be about 2.6 percent per year through 1997 (CMR 1993c; MCP 1993e).

K. HYDROCHLORIC ACID

Hydrochloric acid is one of the top 50 industrial chemicals in the US, ranking 25th and 26th for 1991 and 1992, respectively (C&EN 1993). Its 1992 estimated end-use pattern is as follows (MCP 1993f):

Derivative	**Percent**
Chemical manufacturing	30
Steel pickling	25
Oil & gas well acidizing	20
Food processing	15
Miscellaneous	10

HCl has many uses which include the manufacture of pharmaceutical hydrochlorides, vinyl chloride from acetylene, alkyl chlorides from olefins, and arsenious chloride from arsenious oxide. HCl is also used in the dissolution of minerals, pickling and etching of metals, regeneration of ion-exchange resins for water treatment, neutralization of alkaline products or waste materials, acidification of brine in chlor-alkali electrolysis, production of tin and tantalum, as an analytical reagent deliming agent for hides, coagulation of latex, pH control, desulfurization agent for petroleum, hydrolyzing starch and proteins in the preparation of various food products, cleaning boilers, and heat-exchange equipment, pharmaceutic aid as acidifier, as a gastric acidifier in veterinary medicine, in the chlorination of rubber, as a gaseous flux for babbitting operations, and in isomerization, polymerization, and alkylation reactions (USEPA 1994e).

Other uses of HCl include phosphoric acid production, silica gel production, preparation of dyes and dye intermediates, reclamation of rubber, production of casein plastics, manufacture of paint pigments, and for etching airport runways in preparation for resurfacing with bonded concrete (USEPA 1994e).

Overall demand for hydrochloric acid is projected to grow annually by only 1 - 2 percent for the next five years (MCP 1993f).

L. HYDROGEN FLUORIDE

The estimate of hydrogen fluoride's (HF) end-use pattern is as follows (CMR 1991a):

Derivative	Percent
Fluorocarbons	58
Aluminum manufacture (captive HF)	15
Petroleum alkylation catalysis	4
Stainless steel pickling	4
Uranium chemical production	3
Aluminum manufacture (merchant HF)	3
Miscellaneous (glass etching, herbicides, rare metals, fluoride salts, and specialty fluorides)	13

Hydrogen fluoride is primarily used in the production of fluorocarbons (CFCs), which are being phased out. The hydrogen fluoride consumed by the aluminum industry (18% of production) is used to produce synthetic cryolite, which is used in the reduction of aluminum in electrolysis cells; this process gives off hydrogen fluoride which may be recycled (captive HF). Hydrogen fluoride is also used in the production of branched alkane motor fuels, aerosols, plastics, and refrigerants. In the field of atomic energy, it is used in the production of uranium tetrafluoride from uranium oxide, and it is used in certain types of rocket fuels. Hydrogen fluoride is also used in cleaning cast iron, copper, and brass; removing efflorescence from brick and stone, or sand particles from metallic castings; working over too heavily weighted silks, frosting and etching glass and enamel; polishing crystal glass; decomposing cellulose; enameling and galvanizing iron; and increasing porosity of ceramics. Hydrogen fluoride salts are used as insecticides, to arrest undesirable fermentation in brewing, and in analytical work to determine SiO_2 (USEPA 1993g).

Historically, hydrogen fluoride grew at a rate of minus 0.4 percent per year from 1981 through 1990; however, future growth is projected to range from 0 to 2 percent per year through 1995 (CMR 1991a).

M. MALEIC ANHYDRIDE

The 1992 estimate of maleic anhydride's end-use pattern is as follows (MCP 1992a):

Derivative	Percent
Unsaturated polyester resins	57
Fumaric & malic acid	10
Lube oil additives	10
Maleic co-polymers	8
Agricultural chemicals	5
Miscellaneous	10

Polyester and alkyd resins (where up to 10 mole percent of maleic anhydride may be substituted for phthalic anhydride in alkyd resins), in particular, are used to make fiberglass reinforced plastics in the construction and electrical industries, in pipeline and marine construction, and in textile finishing. Maleic co-polymers are utilized in coatings, varnishes, and thermoplastics (MCP 1992a; USEPA 1993h).

Fumaric acid is produced from maleic anhydride and it is used as a food acidulant and in the production of resin and rosin adducts for paper sizing. Fumaric acid is also used to manufacture malic acid, also a food acidulant. Many surface active agents, ranging from lubricant additives to wetting agents, depend on maleic anhydride (MCP 1992a).

Agricultural chemicals that are produced from maleic anhydride include the pesticides captan and malathion, and the growth inhibitor maleic acid hydrazide. Maleic anhydride is also added to drying oils to reduce the drying time and improve the coating qualities of lacquers. Other uses include sulfosuccinic acid esters and alkenyl succinic anhydrides production (USEPA 1993h).

While historical growth rates averaged 4.3 percent per year (1982 - 1991) for maleic anhydride, future growth through 1996 will average 3 percent per year (CMR 1992d; MCP 1992a).

N. METHYL ISOBUTYL KETONE

Methyl isobutyl ketone (MIBK) is used primarily as a solvent in protective coatings, with a relatively minor amount used in some specialty adhesive and ink formulations. The end-use pattern (1992 estimate) for MIBK was (MCP 1993g):

Derivative	Percent
Protective coatings	62

Intermediate	18
Process solvent	13
Miscellaneous	7

As an intermediate, MIBK is a precursor to various rubber antioxidants and several specialty surfactants. In its role as a process solvent, MIBK is used in the separation and purification certain metal ions, in the extraction and purification of antibiotics and other pharmaceuticals, in the manufacturing of insecticides and other pesticides, and in other minor solvent extraction applications. MIBK is also used a denaturant for ethyl alcohol and as a solvent in textile coatings and leather finishing (MCP 1993g).

MIBK, historically, grew at a rate of 4 to 6 percent per year from 1983 through 1992; however, future growth is projected to be minus 3 percent per year through 1997 (CMR 1993d).

O. METHYL METHACRYLATE

Methyl methacrylate (MMA), in 1993, had the following end-use pattern (CMR 1994b):

Derivative	**Percent**
Acrylic plastics and resins	
Cast and extruded	32
Molding powders/resins	15
Surface coatings	24
Impact modifiers	13
Emulsion polymers	8
Mineral-based sheet	3
Higher methacrylates	2
Polyester modifiers	2
Miscellaneous	1

Acrylic sheeting, made by casting, molding, or extrusion of poly(MMA) or modified polymers, is the largest application for MMA. Methyl methacrylate polymers and copolymers are used in water-borne, solvent, and solventless coatings for a variety of both commercial and industrial applications. Solvent and emulsion polymers containing methacrylates are used in adhesives, sealants, leather coatings, paper coatings, inks, floor polishes, and textile finishes. Specialty polymers are used dentistry and leaded radiation shields (MCP 1992b).

Growth for MMA is tied to the overall health of the US economy. A prosperous domestic auto industry, coupled with strong demand for housing, should give MMA a 3 to 4 percent annual growth rate through 1998. During the period 1984 - 1993, MMA grew at an annual rate of 2 to 3 percent (CMR 1994b).

P. NAPHTHALENE

The principal application for naphthalene is the production of phthalic anhydride, which is used to make plasticizers, unsaturated polyester resins, and alkyd resins. The 1993 end-use pattern is estimated as follows (CMR 1993e; MCP 1993h):

Derivative	**Percent**
Phthalic anhydride	65
Surfactants and dispersants	13
Insecticides	11
Moth repellant	6
Synthetic tanning agents	3
Miscellaneous	2

Naphthalene is a raw material that is used to produce a number of commercially important chemicals. Phthalic anhydride, an intermediate for PVC plasticizers, resins, and insecticides, is made from naphthalene by catalytic vapor-phase oxidation. Naphthalene is a feedstock for the manufacture of 2-naphthol and naphthalene sulfonic acid, which are used as intermediates in the synthesis of azo dyes. Naphthalene and alkylnaphthalene sulfonates are used as surfactants. Naphthalene sulfonate-formaldehyde condensates find use as tanning agents and dispersants for concrete. It is hydrogenated to produce the solvents tetralin and decalin. Diisopropylnaphthalenes are used as solvents for carbonless copy paper.

Naphthalene is also used to make chemicals that are used as pesticides, plant growth regulators, polyester/polyamide polymers, lube-oil additives, dispersants, flue gas desulfurization, and wood preservatives. Naphthalene itself is used as a moth repellant (USEPA 1993k).

During the ten-year period from 1983 to 1992, naphthalene grew annually at a rate of minus 3 percent; however, it is forecast to grow annually through 1997 at a rate of 2 to 3 percent (CMR 1993e).

Q. PHENOL

Phenol is one of the top 50 industrial chemicals in the US, ranking 35th and 34th for 1991 and 1992, respectively (C&EN 1993). Phenol's largest use is as a synthetic intermediate. Its estimated end-use pattern is (CMR 1993f):

Derivative	Percent
Bisphenol A	35
Phenolic resins	34
Caprolactam	15
Aniline	5
Alkylphenols	5
Xylenols	5
Miscellaneous	1

Bisphenol A is used primarily to produce epoxy and polycarbonate resins; a smaller amount is used to make phenoxy, polysulfone, and polyester resins. The largest use for phenolic resins is for adhesives (plywood), followed by binders for insulation (fiberglass, mineral wool, etc.), impregnating and laminating agents (for plastic and wood laminates), and for molding compounds and foundry resins. Caprolactam is used to make nylon-6, molding resin, or film forms. Aniline has numerous uses, such as in rubber processing compounds, dyes, pesticides, etc. Alkylphenols are used to produce surface active agents, emulsifiers, antioxidants, and lube oil additives. Xylenols are used to manufacture polyphenylene oxide, an engineering plastic (MCP 1992c).

Numerous miscellaneous applications include use as a general disinfectant, an additive in germicidal paints and slimicides, a selective solvent for refining lubricating oils, and in numerous medicinal and over-the-counter health and beauty aids (USEPA 1994f).

Historically, phenol grew at a rate of 3 to 4 percent per year from 1983 through 1992; however, future growth is projected to remain stable through 1997 with an annual grow rate of 3 to 4 percent (CMR 1993f).

R. PHTHALIC ANHYDRIDE

Phthalic anhydride's estimated end-use pattern for 1992 is (MCP 1993i):

Derivative	Percent
Phthalate plasticizers	53
Unsaturated polyesters	22
Alkyd resins	18
Miscellaneous	7

Phthalate plasticizers are used mainly to compound flexible polyvinyl chloride. Fiberglass-reinforced, unsaturated polyester resins are employed in numerous molding applications. Alkyd resins are a major workhorse in protective coating formulations. Miscellaneous uses include dyes, pigments, and polyester polyols. Phthalic anhydride is also used as a curing agent for epoxy resins that have important coating and structural applications (MCP 1993i; USEPA 1993l).

Phthalic anhydride, historically, grew at a rate of 2.8 percent per year from 1982 through 1991; however, future growth is projected to be 2 percent per year through 1996 (CMR 1992e).

S. 1,2,4-TRICHLOROBENZENE

Trichlorobenzenes are used as a component in some pesticides, as a dye carrier, in dielectric fluids, in lubricants, as a heat-transfer medium, and as an organic intermediate and solvent used in chemical manufacturing; however, the market for these uses is small and declining. Of the trichlorobenzenes, only 1,2,4-trichlorobenzene and 1,2,3-trichlorobenzene are sold in larger than research quantities. Dye carriers are used in the textile industry to achieve complete dye penetration of polyester fibers. They loosen the interpolymer dyes and allow water insoluble dyes to penetrate into the fiber. Trichlorobenzenes are one of the most commonly used dye carriers. 1,2,4-Trichlorobenzene was one of the most frequently used solvents in a gallium-arsenide wafer fabrication facility employing about 70 workers (USEPA 1993n).

No published market trend or growth rate data have been identified for 1,2,4-trichlorobenzene.

T. 1,1,2-TRICHLOROETHANE

Primarily important only as a feedstock intermediate in the production of vinylidene chloride and to some extent in the synthesis of tetrachloroethanes, 1,1,2-trichloroethane as a solvent for chlorinated rubbers, electronic components, pharmaceuticals, and other substances which may require high solvency properties. However, 1,1,2-trichloroethane's relatively high toxicity does not permit its general use as a solvent (USEPA 1994g). No end-use pattern has been identified in the literature searched.

U. VINYLIDENE CHLORIDE

Vinylidene chloride is used to manufacture poly(vinylidene chloride) (PVDC) and its copolymers with vinyl chloride, acrylonitrile, and acrylates. These polymers possess outstanding resistance to chemical attack and are efficient gas barriers. They are used for food packaging films (e.g., Saran Wrap), in paints and coatings, and in coatings for controlled-released fertilizers. Approximately 60 to 80 percent of vinylidene chloride production is used to manufacture PVDC and its copolymers; the rest is converted into 1,1,1-trichloroethane (USEPA 1994h).

IV. TESTING COSTS / ECONOMIC ANALYSIS

A. TESTING COSTS

The estimated test costs for the 21 hazardous air pollutants are based on the tests required in the amended HAPs proposal. These tests, their estimated laboratory costs, and their laboratory labor hours are presented in Table 24.[5] A detailed discussion of the development of public reporting burden hour estimates is presented in Appendix C of this report.[6]

Total laboratory costs are estimated to range between 18.2 and 31.6 million dollars. The cost range in laboratory costs reflects the variations in testing protocols and cost differences among laboratories. The specific testing requirements and laboratory costs for each chemical are shown in Table 25.

In addition to laboratory costs, expenses associated with the administration of the testing program are incurred by the companies subject to the test rule. These administrative costs are estimated to be 25 percent of the laboratory costs (i.e., 4.5 to 7.9 million dollars). These activities include soliciting laboratory bids, selection of laboratories, preparing test protocols, monitoring tests under progress, developing cost sharing agreements, preparing reports to EPA on the testing, and auditing the laboratories for compliance with EPA's Good Laboratory Practice (GLP) standards. The 25 percent estimate is based on a survey which examined the actual laboratory and administrative costs incurred in response to several previous test rules.[7]

The total cost of testing, therefore, is the sum of laboratory and administrative costs, or 22.7 to 39.5 million dollars. The best estimate of the total costs of testing is 30.3 million dollars. To permit consistency of comparison, the total test costs are annualized using a cost of capital of seven percent over a period of 15 years, which is believed to be representative of the chemical industry. Thus, the annualized test costs range from 2.5 to 4.3 million dollars. The best estimate of the total annualized test costs is 3.3 million dollars per year. The range of these specific cost elements is summarized as follows:

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[5] A detailed discussion of the development of cost estimates is presented in Appendix B of this report.

[6] "Public reporting burden" means the time, effort, or financial resources expended by persons to generate, maintain, or provide information to or for a Federal agency.

[7] *Review of Economic Impact Methodology Applied to TSCA Section 4 Test Rules*, Draft Report, prepared by Mathtech, Inc., September 23, 1988, under EPA Contract No. 68-02-4235.

COST ELEMENT	MINIMUM ($)	MAXIMUM ($)
Total Laboratory Costs	$18,180,801	$31,598,344
Total Administrative Costs	$4,545,200	$7,899,586
Total Test Costs	$22,726,001	$39,497,930
Total Annualized Test Costs	$2,495,193	$4,336,660

For 19 of the 21 chemicals affected by this proposed rule, the annualized test costs are then divided by the total supply of the chemical (i.e., domestic production plus imports) to derive the unit test costs. The unit test costs, in turn, are divided by the HAP chemical's sales price to determine the impact of the testing requirements. The minimum impact is estimated by dividing the upper-bound sales price into the minimum unit test costs; whereas, the maximum impact is estimated by dividing the upper-bound unit test costs by the minimum sales price.

The impact measure could not be applied to carbonyl sulfide since it is a byproduct for which there is no market price. For carbonyl sulfide, the potential impact of these testing costs was approximated using the total supply and market price of carbon black, one of the products associated with the byproduction of carbonyl sulfide. The approximated impact for carbonyl sulfide is an overestimate, as the total burden of testing is allocated to a single product associated with the byproduction of carbonyl sulfide. The approximated impact ranges are well under the one percent benchmark.

This impact measure could not be applied to 1,2,4-trichlorobenzene because there is no publicly available data on quantity produced. The precise impact can only be evaluated with CBI data. However, at a sales price of $1.25 per pound, supply volume would have to be below 8.6 million pounds for a price impact of 1 percent or greater. Table 28 shows the hypothetical supply volumes necessary to support a 1 percent price impact.

The analysis for 19 of the 21 HAP chemicals is summarized in Table 26. Alternative analyses of carbonyl sulfide and 1,2,4-trichlorobenzene are reported in Section IV.B of this report.

Table 24: US EPA Required Tests and Their Estimated Laboratory Costs ($) and Labor Hours

Protocol Title	Citation	Species Rqd./Avail. [a]	Route Rqd./Avail. [b]	Additional Information	Cost			Lab Labor Hours
					Best	Min.	Max.	
Acute Inhalation Toxicity	799.9135	--/Rat	Inhal./Inhal.	Vapor	60,457	49,531	72,260	693
				Aerosol	60,901	49,901	72,789	701
				Average [c]	**60,679**	**49,716**	**72,525**	**697**
Acute Modification	(ASTM E 981-84)	Mouse/Mouse	Nose Cone/ Nose Cone	None	9,350	7,224	11,624	109
				Total	**70,029**	**56,940**	**84,149**	**806**
Neurotoxicity Screen	799.9620	--/Rat	Inhal./Gavage	4-hour	102,463	85,240	121,549	925
			Inhal./Dietary	90-day	168,512	133,501	206,200	1,387
				Total [d]	**270,975**	**218,741**	**327,748**	**2,312**
Subchronic	799.9346	--/Rat	Inhal./Inhal.	None	273,700	161,240	389,030	2,458
Subchronic Modification	FR	--/Rat	Inhal./Inhal.	None	54,740	32,248	77,806	492
				Total	**328,440**	**193,488**	**466,836**	**2,950**
Developmental	799.9370	2 Mammalian Species/Rat, Mouse, Rabbit	Inhal./Inhal.	Rat	86,560	67,882	106,529	1,291
			Inhal./Inhal.	Mouse, Vapor	88,295	69,204	108,782	1,361
				Mouse, Aerosol	87,306	68,478	107,516	1,385
				Average [c]	**87,800**	**68,841**	**108,149**	**1,373**
			Inhal./Gavage	Rabbit	161,729	129,074	196,022	1,157
				Total	**336,089**	**265,797**	**410,700**	**3,821**
				Total * 2/3 [e]	**224,060**	**177,198**	**273,800**	**2,547**
Reproductive	799.9380	--/Rat	Inhal./Gavage	None	566,221	426,092	765,601	5,024
Carcinogenicity	799.9420	Male Rat & Female Mouse Or Unspecified/ M. Rat & F. Mouse	Inhal./Inhal.	Rat	841,280	672,800	1,097,450	11,683
				Mouse	686,580	549,240	891,730	9,800
				Blend [f]	**763,930**	**611,020**	**994,590**	**10,742**
Immunotoxicity	799.9780	--/Rat	Inhal./Gavage	None	73,137	52,801	96,412	415
In Vivo Bone Marrow	799.9538	--/Rat	Inhal./Gavage	None	38,302	31,460	45,705	394
In Vivo Erythrocyte	799.9539	--/Mouse	Inhal./Inhal.	1-day test	13,300	10,640	16,120	135
				3-day test	14,530	11,660	17,590	158
				Average	**13,915**	**11,150**	**16,855**	**147**
Mutation-Somatic Cell Culture	799.9530	--/CHO,HGPRT --/Mouse, Both have same cost	N/A	N/A	16,066	12,766	19,641	144
E. Coli - Mutation	799.9510	N/A	N/A	Azo	5,960	4,460	7,520	49
				Direct	5,850	4,380	7,400	47
				Average [g]	**5,905**	**4,420**	**7,460**	**48**

a) Species required in proposed rule is listed first, followed by the species for which cost data are available.
b) Route required in proposed rule is listed first, followed by the route for which cost data are available.
c) Requirements don't specify phase, so use average of aerosol and vapor phases.
d) 4-hour results may trigger 90-day test, so assume 90-day test costs always added.
e) Take 2 out of 3 species = (Rat cost/3 + Mouse cost/3 + Rabbit cost/3) * 2.
f) Same calculation used for two scenarios: (1) Male rat and female mouse required, so blend costs: Rat cost/2 + Mouse cost/2 = x.
(2) When species are not specified, use of a rat or mouse is assumed, and the average costs for the 2 species are used (same formula as blended costs).
g) Use average of Azo reduction and direct plate costs. E. Coli can now be used as 1 of 5 assays required. Costs are similar for E. Coli and salmonella, so no change in previously estimated cost is anticipated.

Table 25: US EPA Required Tests and Their Estimated Laboratory Costs for the 21 Hazardous Air Pollutants

HAP Compound	Protocol Title	Cost [a]			Laboratory Labor Hours
		Best	Min.	Max.	
1,1,2-Trichloroethane	Acute Inhalation Toxicity & Modification	70,029	56,940	84,149	806
	Subchronic	328,440	193,488	466,836	2,950
	Developmental	224,060	177,198	273,800	2,547
	Reproductive	566,221	426,092	765,601	5,024
	Neurotoxicity Screen	270,975	218,741	327,748	2,312
	Carcinogenicity	763,930	611,020	994,590	10,742
	In Vivo Bone Marrow	38,302	31,460	45,705	394
	In Vivo Erythrocyte	13,915	11,150	16,855	147
	Immunotoxicity	73,137	52,801	96,412	415
	Total	**2,349,008**	**1,778,890**	**3,071,696**	**25,336**
1,2,4-Trichlorobenzene	Acute Inhalation Toxicity & Modification	70,029	56,940	84,149	806
	Developmental	224,060	177,198	273,800	2,547
	Neurotoxicity Screen	270,975	218,741	327,748	2,312
	Immunotoxicity	73,137	52,801	96,412	415
	Total	**638,200**	**505,680**	**782,109**	**6,080**
Biphenyl	Acute Inhalation Toxicity & Modification	70,029	56,940	84,149	806
	Subchronic	328,440	193,488	466,836	2,950
	Developmental	224,060	177,198	273,800	2,547
	Reproductive	566,221	426,092	765,601	5,024
	Neurotoxicity Screen	270,975	218,741	327,748	2,312
	Immunotoxicity	73,137	52,801	96,412	415
	Total	**1,532,861**	**1,125,260**	**2,014,546**	**14,054**
Carbonyl Sulfide	Acute Inhalation Toxicity & Modification	70,029	56,940	84,149	806
	Subchronic	328,440	193,488	466,836	2,950
	Developmental	224,060	177,198	273,800	2,547
	Reproductive	566,221	426,092	765,601	5,024
	Neurotoxicity Screen	270,975	218,741	327,748	2,312
	Carcinogenicity	763,930	611,020	994,590	10,742
	E. Coli Mutation	5,905	4,420	7,460	48
	Mutation-Somatic Cell Culture	16,066	12,766	19,641	144
	In Vivo Bone Marrow	38,302	31,460	45,705	394
	In Vivo Erythrocyte	13,915	11,150	16,855	147
	Immunotoxicity	73,137	52,801	96,412	415
	Total	**2,370,979**	**1,796,076**	**3,098,797**	**25,528**
Chlorine	Acute Inhalation Toxicity & Modification	70,029	56,940	84,149	806
	Total	**70,029**	**56,940**	**84,149**	**806**
Chlorobenzene	Acute Inhalation Toxicity & Modification	70,029	56,940	84,149	806
	Subchronic	328,440	193,488	466,836	2,950
	Neurotoxicity Screen	270,975	218,741	327,748	2,312
	Immunotoxicity	73,137	52,801	96,412	415
	Total	**742,581**	**521,970**	**975,145**	**6,483**
Chloroprene	Acute Inhalation Toxicity & Modification	70,029	56,940	84,149	806
	Reproductive	566,221	426,092	765,601	5,024
	Neurotoxicity Screen	270,975	218,741	327,748	2,312
	Immunotoxicity	73,137	52,801	96,412	415
	Total	**980,362**	**754,574**	**1,273,910**	**8,557**
Cresols (each isomer)	Acute Inhalation Toxicity & Modification	70,029	56,940	84,149	806
	Subchronic	328,440	193,488	466,836	2,950
	Neurotoxicity Screen	270,975	218,741	327,748	2,312
	Immunotoxicity	73,137	52,801	96,412	415
	Total	**742,581**	**521,970**	**975,145**	**6,483**
Diethanolamine	Acute Inhalation Toxicity & Modification	70,029	56,940	84,149	806
	Subchronic	328,440	193,488	466,836	2,950
	Developmental	224,060	177,198	273,800	2,547
	Reproductive	566,221	426,092	765,601	5,024
	Neurotoxicity Screen	270,975	218,741	327,748	2,312
	Immunotoxicity	73,137	52,801	96,412	415
	Total	**1,532,861**	**1,125,260**	**2,014,546**	**14,054**

Table 25: US EPA Required Tests and Their Estimated Laboratory Costs for the 21 Hazardous Air Pollutants

HAP Compound	Protocol Title	Cost [a]			Laboratory Labor Hours
		Best	**Min.**	**Max.**	
Ethylbenzene	Acute Inhalation Toxicity & Modification	70,029	56,940	84,149	806
	Developmental	224,060	177,198	273,800	2,547
	Reproductive	566,221	426,092	765,601	5,024
	Neurotoxicity Screen	270,975	218,741	327,748	2,312
	Immunotoxicity	73,137	52,801	96,412	415
	Total	**1,204,421**	**931,772**	**1,547,710**	**11,104**
Ethylene Dichloride	Acute Inhalation Toxicity & Modification	70,029	56,940	84,149	806
	Subchronic	328,440	193,488	466,836	2,950
	Developmental	224,060	177,198	273,800	2,547
	Reproductive	566,221	426,092	765,601	5,024
	Neurotoxicity Screen	270,975	218,741	327,748	2,312
	Total	**1,459,725**	**1,072,459**	**1,918,134**	**13,639**
Ethylene Glycol	Acute Inhalation Toxicity & Modification	70,029	56,940	84,149	806
	Subchronic	328,440	193,488	466,836	2,950
	Neurotoxicity Screen	270,975	218,741	327,748	2,312
	Immunotoxicity	73,137	52,801	96,412	415
	Total	**742,581**	**521,970**	**975,145**	**6,483**
Hydrochloric Acid	Acute Inhalation Toxicity & Modification	70,029	56,940	84,149	806
	Total	**70,029**	**56,940**	**84,149**	**806**
Hydrogen Fluoride	Acute Inhalation Toxicity & Modification	70,029	56,940	84,149	806
	Subchronic	328,440	193,488	466,836	2,950
	Developmental	224,060	177,198	273,800	2,547
	Reproductive	566,221	426,092	765,601	5,024
	Neurotoxicity Screen	270,975	218,741	327,748	2,312
	Immunotoxicity	73,137	52,801	96,412	415
	Total	**1,532,861**	**1,125,260**	**2,014,546**	**14,054**
Maleic Anhydride	Acute Inhalation Toxicity & Modification	70,029	56,940	84,149	806
	Developmental	224,060	177,198	273,800	2,547
	Neurotoxicity Screen	270,975	218,741	327,748	2,312
	Carcinogenicity	763,930	611,020	994,590	10,742
	Immunotoxicity	73,137	52,801	96,412	415
	Total	**1,402,130**	**1,116,700**	**1,776,699**	**16,822**
Methyl Isobutyl Ketone	Acute Inhalation Toxicity & Modification	70,029	56,940	84,149	806
	Reproductive	566,221	426,092	765,601	5,024
	Immunotoxicity	73,137	52,801	96,412	415
	Total	**709,387**	**535,833**	**946,162**	**6,245**
Methyl Methacrylate	Acute Inhalation Toxicity & Modification	70,029	56,940	84,149	806
	Developmental	224,060	177,198	273,800	2,547
	Reproductive	566,221	426,092	765,601	5,024
	Neurotoxicity Screen	270,975	218,741	327,748	2,312
	Immunotoxicity	73,137	52,801	96,412	415
	Total	**1,204,421**	**931,772**	**1,547,710**	**11,104**
Naphthalene	Acute Inhalation Toxicity & Modification	70,029	56,940	84,149	806
	Reproductive	566,221	426,092	765,601	5,024
	Immunotoxicity	73,137	52,801	96,412	415
	Total	**709,387**	**535,833**	**946,162**	**6,245**
Phenol	Acute Inhalation Toxicity & Modification	70,029	56,940	84,149	806
	Immunotoxicity	73,137	52,801	96,412	415
	Total	**143,166**	**109,741**	**180,561**	**1,221**
Phthalic Anhydride	Acute Inhalation Toxicity & Modification	70,029	56,940	84,149	806
	Subchronic	328,440	193,488	466,836	2,950
	Developmental	224,060	177,198	273,800	2,547
	Reproductive	566,221	426,092	765,601	5,024
	Neurotoxicity Screen	270,975	218,741	327,748	2,312
	Carcinogenicity	763,930	611,020	994,590	10,742
	Immunotoxicity	73,137	52,801	96,412	415
	Total	**2,296,791**	**1,736,280**	**3,009,136**	**24,795**
Vinylidene Chloride	Acute Inhalation Toxicity & Modification	70,029	56,940	84,149	806
	Neurotoxicity Screen	270,975	218,741	327,748	2,312
	Total	**341,004**	**275,681**	**411,897**	**3,118**

a) Best, Minimum, and Maximum costs represent the corresponding Total costs from Table 24.

Table 26: Summary of Annualized and Unit Test Costs with Associated Price Impacts for the 21 Hazardous Air Pollutants

HAP Chemical	Total Lab Cost ($)		Total Admin. Cost ($)		Total Test Costs ($)		Annualized Test Costs ($)		Total Supply (000 lbs) (production + imports)*		Unit Test Costs ($/lb)		Sales Price ($/lb)*		Price Impact (%)	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
1,1,2-Trichloroethane	1,778,890	3,071,696	444,723	767,924	2,223,613	3,839,620	244,141	421,570	242,550	242,550 d	0.001007	0.001738	0.42	0.42	0.2397	0.4138 d
1,2,4-Trichlorobenzene	505,680	782,109	126,420	195,527	632,100	977,636	69,401	107,339	10,000	10,000 e	0.006940	0.010734	1.25	1.25	0.5552	0.8587 a
Biphenyl	1,125,260	2,014,546	281,315	503,637	1,406,575	2,518,183	154,434	276,483	59,247	59,247 d	0.002607	0.004667	0.64	0.74	0.3522	0.7292 d
Carbonyl Sulfide	1,796,076	3,098,797	449,019	774,699	2,245,095	3,873,496	246,499	425,289	3,340,000	3,340,000 d	0.000074	0.000127	0.30	0.30	0.0246‡	0.0424 ‡
Chlorine	56,940	84,149	14,235	21,037	71,175	105,186	7,815	11,549	24,790,000	24,790,000 a	0.000000	0.000000	0.09	0.09	0.0004	0.0005 a
Chlorobenzene	521,970	975,145	130,493	243,786	652,463	1,218,931	71,637	133,832	185,000	185,000 a	0.000387	0.000723	0.55	0.55	0.0704	0.1315 a
Chloroprene	754,574	1,273,910	188,644	318,478	943,218	1,592,388	103,560	174,836	154,000	154,000 a	0.000672	0.001135	1.89	1.89	0.0356	0.0601 a
Cresols (3 isomers)	1,565,910	2,925,435	391,478	731,359	1,957,388	3,656,794	214,911	401,496	90,619	90,619 d	0.002372	0.004431	0.73	1.88	0.1261	0.6069 a
Diethanolamine	1,125,260	2,014,546	281,315	503,637	1,406,575	2,518,183	154,434	276,483	216,911	216,911 d	0.000712	0.001275	0.52	0.52	0.1369	0.2451 d
Ethylbenzene	931,772	1,547,710	232,943	386,928	1,164,715	1,934,638	127,879	212,413	11,923,000	11,923,000 c	0.000011	0.000018	0.16	0.16	0.0067	0.0111 c
Ethylene Dichloride	1,072,459	1,918,134	268,115	479,534	1,340,574	2,397,668	147,188	263,251	17,263,000	17,263,000 b	0.000009	0.000015	0.20	0.22	0.0039	0.0076 a
Ethylene Glycol	521,970	975,145	130,493	243,786	652,463	1,218,931	71,637	133,832	6,600,000	6,600,000 a	0.000011	0.000020	0.30	0.38	0.0029	0.0068 a
Hydrochloric Acid	56,940	84,149	14,235	21,037	71,175	105,186	7,815	11,549	6,706,000	6,706,000 c	0.000001	0.000002	0.04	0.05	0.0023	0.0048 c
Hydrogen Fluoride	1,125,260	2,014,546	281,315	503,637	1,406,575	2,518,183	154,434	276,483	479,974	479,974 d	0.000322	0.000576	0.52	0.52	0.0619	0.1108 d
Maleic Anhydride	1,116,700	1,776,699	279,175	444,175	1,395,875	2,220,874	153,260	243,840	554,000	554,000 b	0.000277	0.000440	0.35	0.39	0.0709	0.1258 a
Methyl Isobutyl Ketone	535,833	946,162	133,958	236,541	669,791	1,182,703	73,539	129,854	184,000	184,000 c	0.000400	0.000706	0.51	0.51	0.0784	0.1384 c
Methyl Methacrylate	931,772	1,547,710	232,943	386,928	1,164,715	1,934,638	127,879	212,413	1,180,000	1,180,000 a	0.000108	0.000180	0.90	0.90	0.0120	0.0200 a
Naphthalene	535,833	946,162	133,958	236,541	669,791	1,182,703	73,539	129,854	240,000	240,000 a	0.000306	0.000541	0.26	0.40	0.0766	0.2081 a
Phenol	109,741	180,561	27,435	45,140	137,176	225,701	15,061	24,781	4,163,000	4,163,000 b	0.000004	0.000006	0.41	0.43	0.0008	0.0015 a
Phthalic Anhydride	1,736,280	3,009,136	434,070	752,284	2,170,350	3,761,420	238,293	412,984	1,005,000	1,005,000 c	0.000237	0.000411	0.35	0.35	0.0677	0.1174 c
Vinylidene Chloride	275,681	411,897	68,920	102,974	344,601	514,871	37,835	56,530	179,190	179,190 d	0.000211	0.000315	0.37	0.37	0.0571	0.0853 d
Total	18,180,801	31,598,344	4,545,200	7,899,586	22,726,001	39,497,930	2,495,193	4,336,660	79,565,491	79,565,491						

* Total supply and price data came from different sources as indicated by the following key codes:

a) Chemical Market Reporter, 1996 and 1997.

b) Chemical & Engineering News, June 24, 1996.

c) Mannsville Chemical Products Corporation, June 1995 (1994 data).

d) U.S. EPA, Section 4 Test Rule Support for 21 Hazardous Air Pollutants, April 4, 1995. (USEPA 1995b)

e) Characterization of 1994 TSCA Chemical Inventory reports

‡ Since carbonyl sulfide is not sold on the open market, Total Supply and Sales Price were not available. Therefore, Total Supply and Sales Price of carbon black, one of the products associated with carbonyl sulfide, were used to calculate the price impact. Since test costs are applied to a single product, this is an overestimate of price impact.

B. ECONOMIC ANALYSIS

A preliminary determination of the potential for significant adverse impact can usually be made on the basis of the anticipated unit test costs for each chemical's manufacturers/importers. In this evaluation, if the annualized unit costs of testing a chemical are less than one percent of the sales price of the chemical, then the potential for adverse economic impact due to the proposed test rule is low. Unit test costs greater than one percent of the chemical's sales price may indicate a greater potential for adverse economic impact. Based on currently available data for the 21 chemicals, no adverse economic impact is found (as shown in Table 26).

As a sensitivity analysis, Table 27 presents the supply volume and sale price necessary for a one percent of price impact level for each HAP chemical. If supply volumes or sales prices were below these levels, price impacts would be greater than one percent for each HAP chemical.[8] A comparison of these supply volumes and sale prices to the ones used in the impact analysis (Table 26) shows that the actual volumes and prices are far above the minimums that would yield a one percent impact. Therefore, the conclusion of no adverse impact is very robust. In other words, this conclusion is not sensitive to differing estimates of testing costs, supply volumes, or sales prices. The two special cases, carbonyl sulfide and 1,2,4-trichlorobenzene, are discussed in more detail below.

[8] For the maximum annualized test cost value for each HAP chemical.

Table 27: Supply Volumes or Sale Prices Necessary for a One Percent Impact Level for Each HAP Chemical

HAP Chemical	Supply Volume (000 lbs)[1] Below	Sales Price ($/lb)[2] Below
1,1,2-Trichloroethane	100,374	0.17
1,2,4-Trichlorobenzene	8,587	CBI
1,1'-Biphenyl	43,200	0.47
Carbonyl Sulfide	141,763	0.01
Chlorine	13,275	0.00
Chlorobenzene	24,333	0.07
Chloroprene	9,251	0.11
Cresols (3 isomers)	54,999	0.44
Diethanolamine	53,170	0.13
Ethyl Benzene	132,758	0.00
Ethylene Dichloride	131,626	0.00
Ethylene Glycol	44,611	0.00
Hydrochloric Acid	32,080	0.00
Hydrogen Fluoride	53,170	0.06
Maleic Anhydride	69,669	0.04
Methyl Isobutyl Ketone	25,462	0.07
Methyl Methacrylate	23,601	0.02
Naphthalene	49,944	0.05
Phenol	6,044	0.00
Phthalic Anhydride	117,995	0.04
Vinylidene Chloride	15,278	0.03

1) Minimum sales price and maximum annualized test costs are fixed per data in Table 26.
2) Minimum supply volume and maximum annualized test costs are fixed per data in Table 26.

1. <u>Carbonyl Sulfide</u>

Carbonyl sulfide is not produced in large quantities for commercial applications in the United States. Since no U.S. full-scale commercial production is known to exist, no production data (CBI or non-CBI) are available and no trade statistics are available. Furthermore, no sales price data are available for bulk quantities. Since no actual supply volume or sales price data are obtainable, an impact measure using alternative data was used in this analysis.

To provide an upper bound estimate of the test cost impact, the total annualized testing costs for carbonyl sulfide were compared to the value of carbon black production. Carbon black production is a major generator of carbonyl sulfide, and these producers are expected to bear a substantial share of the testing costs.[9] Since they will not bear all the costs, however, this comparison overestimates the cost impact. In 1995, an estimated 3,340 million pounds of carbon black were produced in the United States, with an average list price of $0.30 per pound.[10] As shown in Table 26, the ratio of unit testing costs to the sales price of carbon black ranges between 0.025 percent and 0.042 percent. This is well below the impact benchmark of one percent. Therefore, adverse impacts on products that generate carbonyl sulfide are not anticipated due to these testing requirements.

2. <u>1,2,4-Trichlorobenzene</u>

1,2,4-Trichlorobenzene has no non-CBI production information; however, CBI supply data does exist and, for 1994, production plus imports totaled ######### pounds (CBI) (USEPA 1995). 1,2,4-Trichlorobenzene has list price of $1.25 per pound (CMR 1994a).

Assuming the sales price remains constant, a supply volume of at least 5.6 - 8.6 million pounds of 1,2,4-trichlorobenzene would be required to support testing at the one percent of price impact level. On the other hand, assuming the supply volume remains constant, a sales price of #### - #### per pound (CBI) would be required to support 1,2,4-trichlorobenzene testing at the one percent of price impact level.

Based upon the current required testing scheme, Table 28 presents the sales price required to support testing at the one percent of sales price impact level for various hypothetical supply volumes of 1,2,4-trichlorobenzene. These range from $13.88 to $21.47 if only 500,000 pounds were produced down to a price of $0.03 to $0.05 if 200 million pounds were produced each year.

While the exact amount of 1,2,4-trichlorobenzene supplied is CBI, the volume of the chemical manufactured and imported exceeded 10 million pounds in 1994. As supply volume exceeds 10 million pounds, the price impact is estimated to be less than one percent.

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[9] For additional information on producers of carbonyl sulfide, see Appendix A.

[10] Chemical Products Synopsis: Carbon Black, Mannsville Chemical Products Corp., September 1995.

Table 28: Sales Price Required to Support Testing of 1,2,4-Trichlorobenzene at the One Percent Level for Various Hypothetical Supply Volumes		
Hypothetical Supply Volume (lbs)	**Sales Price ($/lb) Min.**	**Max.**
500,000	13.88	21.47
750,000	9.25	14.31
1,000,000	6.94	10.73
2,000,000	3.47	5.37
3,000,000	2.31	3.58
4,000,000	1.74	2.68
5,000,000	1.39	2.15
7,500,000	0.93	1.43
10,000,000	0.69	1.07
12,500,000	0.56	0.86
15,000,000	0.46	0.72
17,500,000	0.40	0.61
20,000,000	0.35	0.54
22,500,000	0.31	0.48
25,000,000	0.28	0.43
30,000,000	0.23	0.36
50,000,000	0.14	0.21
75,000,000	0.09	0.14
100,000,000	0.07	0.11
125,000,000	0.06	0.09
150,000,000	0.05	0.07
200,000,000	0.03	0.05

C. IMPACTS ON EXPORTERS

When finalized, the amended HAPs proposal would subject the 21 HAP chemicals to testing under TSCA section 4(a). Under TSCA section 12(b), all exporters of chemicals for which the submission of data is required under TSCA section 4(a) must notify EPA of each country to which a subject chemical is shipped. For chemicals subject to section 4(a), this is a one-time notification requirement (i.e., the exporter only submits the notification when it is exporting a particular chemical for the first time to a country for which it has not previously submitted a notification).

The final HAPs rule will therefore have an impact on exporters of of the HAPs chemicals because the test rule will trigger TSCA section 12(b) reporting requirements. This analysis considered the potential impact of the section 12(b) notification requirements on exporters of these chemicals separately from the impacts of the testing requirements themselves.

Data on export shipments of the HAPs chemicals are limited. While some data sources do present aggregate export volumes for recent years, they do not indicate the number of exporters, number of export shipments, or number of countries exported to. For purposes of this analysis, it would be necessary to know both the number of exporters and the number of countries to which they export each HAP chemical. More specifically, because regulations promulgated pursuant to TSCA section 12(b)—40 CFR part 707— require only a one-time notification per country, data are needed for each HAP chemical on the number of new countries being exported to in each year following promulgation of the rule. These data are not available and there is no apparent reasonable method for modeling the number of notifications.

Given this, the approach used here is to estimate the impact of the notification requirements per chemical and per country. In an analysis of the economic impacts of the July 27, 1993 amendment to the rules implementing TSCA section 12(b) (58 FR 40238), EPA estimated that the one-time cost of preparing and submitting the TSCA section 12(b) notification was $62.60.[11] Inflated through the last quarter of 1996 using the Consumer Price Index, the current cost is estimated to be $69.56. An exporter would have to have annual revenues below $6,956 per chemical/country combination in order to be impacted at a 1 percent or greater level. For example, an exporter filing 3 notifications per year would have to have annual revenues below $20,868 (3 x $6,956) in order to be classified as impacted at the greater than 1 percent level. EPA believes that it is reasonable to assume that few, if any, exporters would file sufficient export notifications to be impacted at or above the 1 percent level. Based on this, the export notification requirements triggered by the proposed HAPs rule would be unlikely to have a significant economic impact on exporters.

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[11] See *Economic Analysis in Support of the Final Rule to Amend Rule Promulgated under TSCA Section 12(b)*, William Silagi, Regulatory Impacts Branch, Office of Pollution Prevention and Toxics, June, 1992.

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